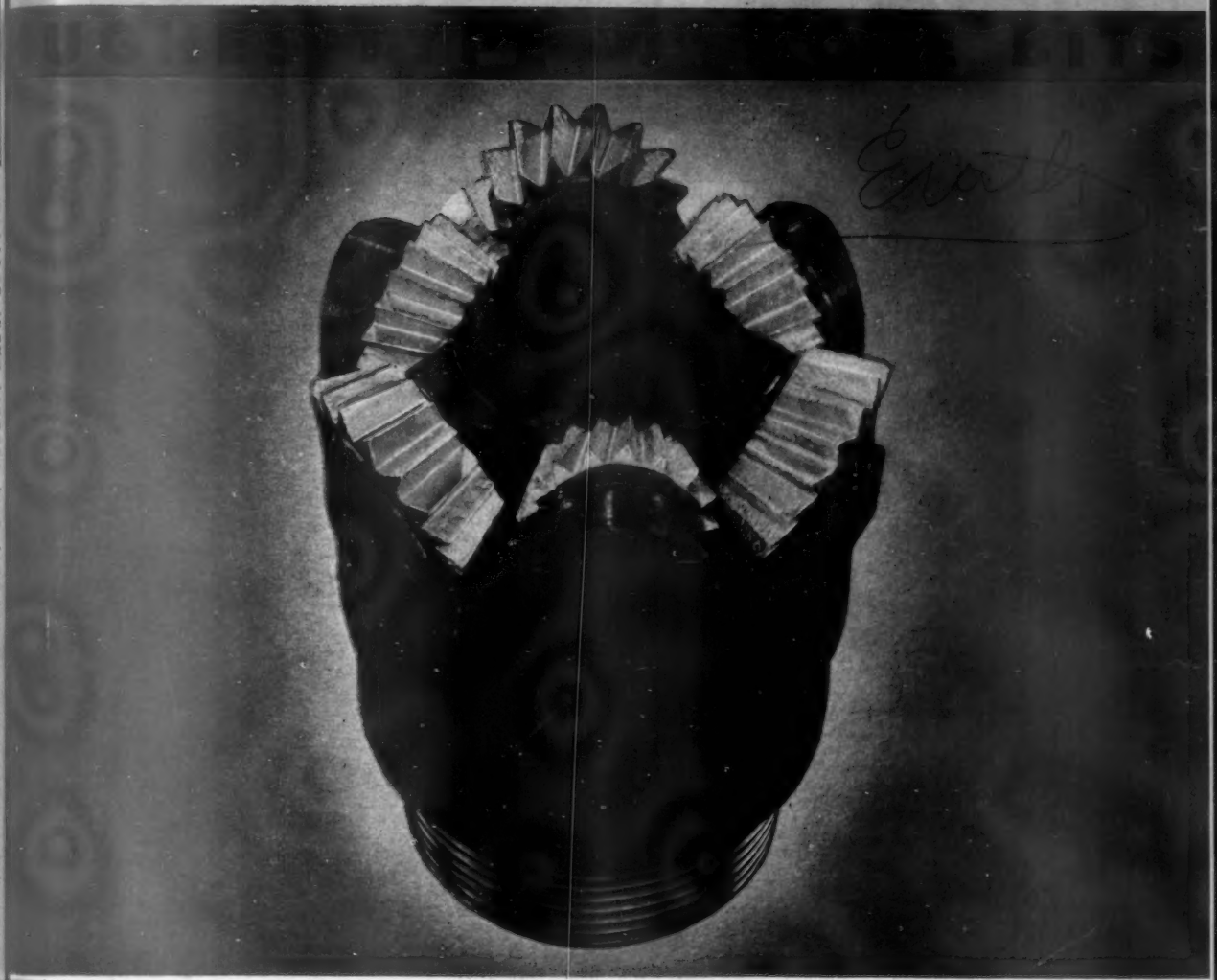
The OIL AND GAS JOURNAL



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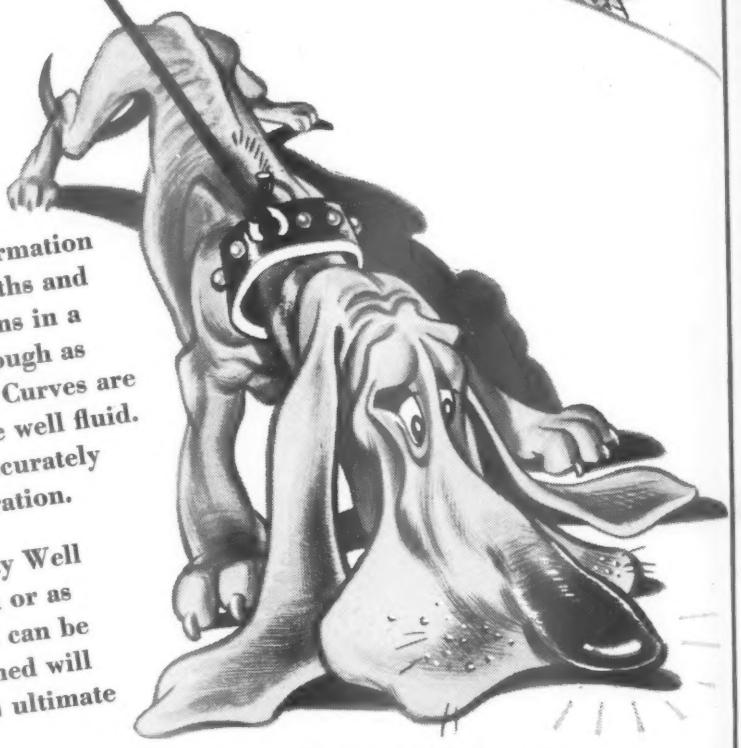

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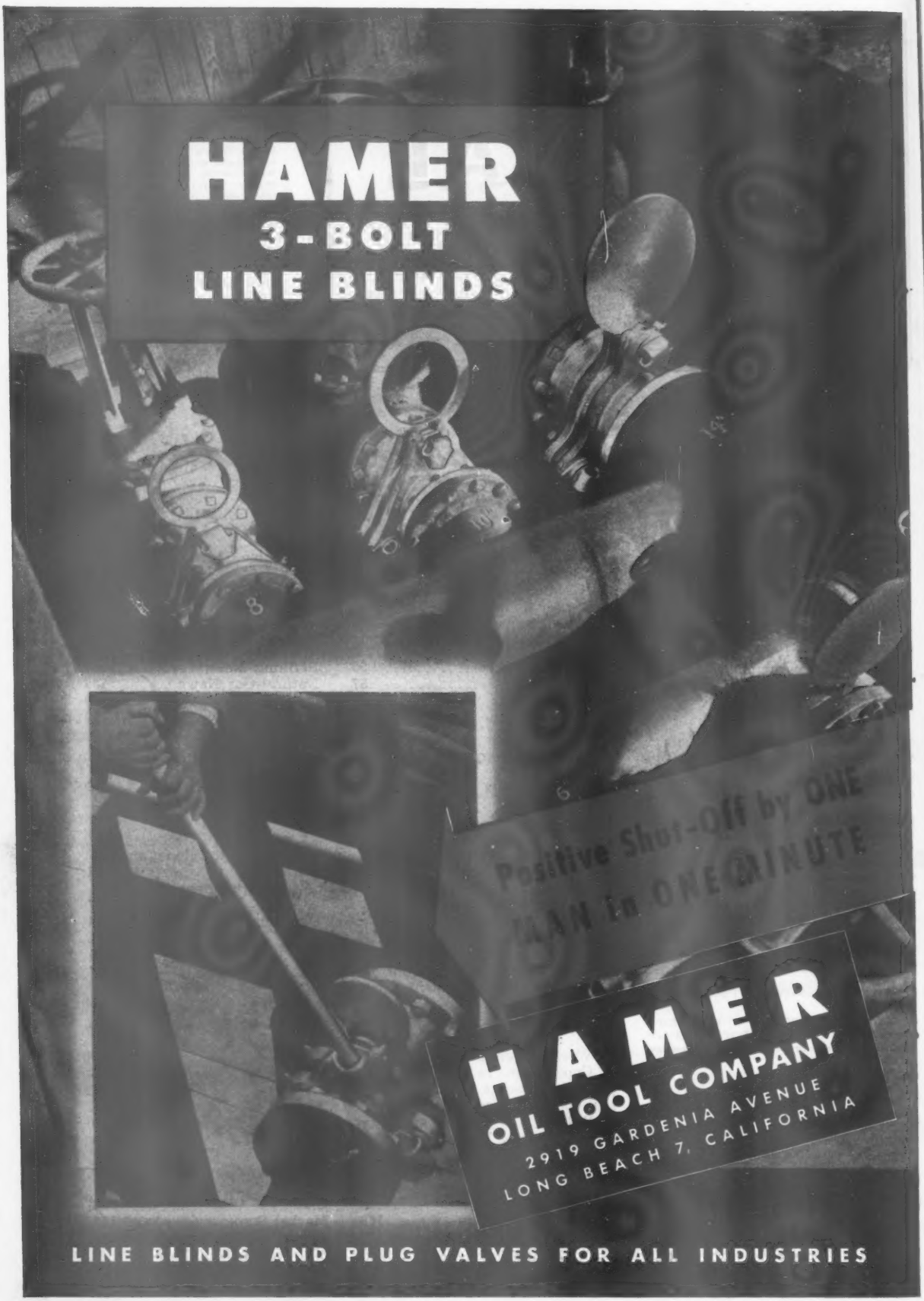
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Trends

Crude-Oil Production
By States—Page 114

CRUDE-OIL STOCKS 218,675,000 bbl. as of March 3—down 676,000 bbl. One year ago 237,763,000 bbl.

GASOLINE STOCKS 97,603,000 bbl. as of March 3—up 1,631,000 bbl. One year ago 85,008,000 bbl.

RESIDUAL FUEL-OIL STOCKS 45,021,000 bbl. as of March 3—down 1,702,000 bbl. One year ago 51,586,000 bbl.

GAS OIL AND DISTILLATE STOCKS 28,110,000 bbl. as of March 3—down 643,000 bbl. One year ago 33,278,000 bbl.

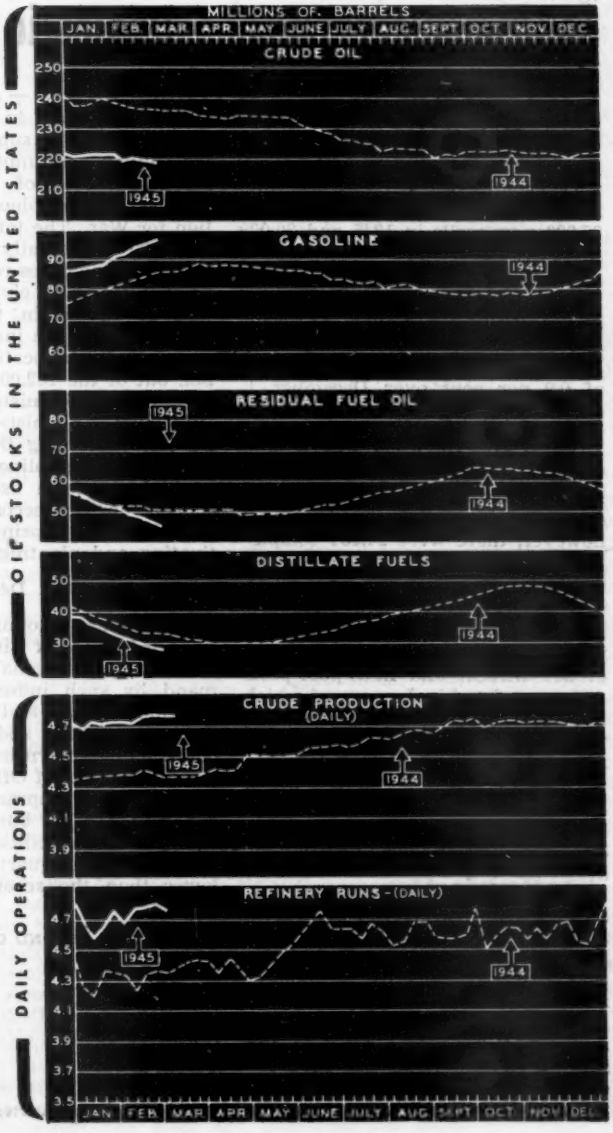
CRUDE OIL PRODUCTION 4,770,750 bbl. as of March 10—up 7,050 bbl. One year ago 4,383,680 bbl.

REFINERY RUNS 4,753,000 bbl. daily week ended March 3—down 50,000 bbl. One year ago 4,376,000 bbl.

REASONABLY definite reports were circulated in oil-trade circles this week that the country's first commercial Fischer-Tropsch plant for conversion of natural gas to liquid petroleum products will be started before the year ends. Site for the operation is said to have been selected near Carthage, in Panola County, East Texas. Research and pilot-plant operation, employing the Fischer-Tropsch process, long has been one of the most intriguing developments in the petroleum industry, chiefly because of its potentialities as a method of reducing vast reserves of natural gas to liquid products.

SELECTION of the Carthage field for the first commercial Fischer-Tropsch plant in this country is a logical choice. The field has been developed chiefly since start of the war. Consequently, minimum spacing regulations of one well to 640 acres have prevailed. Exploration, however, has been even more scattered than required by well-spacing controls. Nearly 50 wells have been completed. Approximately two-thirds of all wells are dual completions, giving a net effective productive total of about 90 producers. The field has open-flow capacity of nearly 2 billion cubic feet per day. Each of the better wells is capable of producing more than 100,000,000 cu. ft. per day, and a few have potentials of 200,000,000 cu. ft. The proven area covers all of Panola County and touches parts of Harrison and other adjacent counties. Productive limits have not been defined in any direction, giving assurance that ultimately the field will cover substantially more than the currently proven 180,000 acres. Proven reserves are estimated between 4 and 5 trillion cubic feet. More optimistic appraisals, doubtless including some factor for prospective development, range up to 11 trillion ultimate producible gas.

THUS, the Carthage field appears to have all requisites for proving the commercial practicality of the Fischer-Tropsch process. Successful operation of the plant, it is felt by producers and refiners alike, would lead to similar installations at other existing and yet-to-be-discovered dry-gas fields. The Carthage operation, reports assert, will be a joint undertaking. Participants will include several large interests in the oil industry, the processing field and in the equipment-manufacturing and engineering phases of the business.



Crude Oil, Producing Materials May Become Increasingly Short

by Henry D. Ralph

WASHINGTON.—The shortage of crude oil and of materials to produce it will increase in severity during the remainder of the year if fighting in Europe continues, the production committee of the Petroleum Industry War Council was told this week in reports submitted by the materials and production divisions of the Petroleum Administration for War.

A revised chart on U. S. crude requirements and productive capacity showed that requirements for crude oil will be considerably in excess of production all during 1945 and 1946, necessitating increased imports and that actual production will be somewhat above the maximum efficient rate though not enough to endanger the fields. However, the maximum efficient rate will fall off very rapidly unless manpower and materials are available to complete 27,000 new wells in 1945 and 30,000 in 1946.

Crude production fell 60,000 bbl. in daily average during December and there was an equivalent drainage on stocks. Total wells drilling January 1 were 3,773, an increase of 0.9 per cent over December 1. Completions during January were 1,697 which was below the first quarter goal of 2,000 per month. There were only 1,691 rotary rigs running January 1 compared with 1,814 last November. During 1944, however, there were 24,154 completions compared with the goal of 24,000.

During January there were 522 geophysical and 50 core-drill crews working, an all-time high. A total of 284 wildcat and new pool tests were completed in January of which 238 were dry, 37 were oil and 9 were gas discoveries. Fourteen states reported discoveries during January.

The materials situation as a whole is more serious than at the last report 2 months ago, in spite of the fact that the outlook for tubular goods has improved somewhat and the situation will become increasingly difficult as the war progresses in Europe.

In January, it appeared that the combined requirements for bombs, rockets, and oil-country tubular goods exceeded the capacity of pipe mills by 145,200 tons. Since then, the shortage for all items has been reduced to 27,000 tons by modifying military specifications to permit other types of mills to be utilized. However, unless further adjustments can be made, the oil industry will be short of materials to produce some 600 wells scheduled for the second quarter. In an attempt to find materials for 600 wells, PAW is making another inventory survey of the oil industry to obtain complete details for submission to the War Production Board.

Tool joint deliveries are improving due to progressive completion of a program of expanding facilities and the backlog of manufacturers' orders in now 12.3 months, the first decline in more than a year.

Production of drill pipe in the first quarter will be considerably above previous rates but during the remainder of the year it may be seriously affected by the situation in the seamless tube mills.

A special report on crude reserves was included in the production division review, consisting of six charts covering the period 1900 to 1943. These charts showed that the crude reserve of the United States increased steadily to 1938, when it reached a peak of nearly 24,500,000,000 bbl. or 20 years' indicated supply but has since declined to 21,500,000,000 bbl., or 14 years' supply on January 1, 1945.

Domestic Gasoline Supply Increased

WASHINGTON. — A 132,000 - bbl. daily increase in domestic automotive gasoline supplies allocated for civilian consumption during the second quarter of 1945 was announced by Petroleum Administration for War. The total allocation of 1,276,000 bbl. daily was divided among the agencies representing the various types of civilian consumption as shown in the tabulation.

The bulk of the increase over the first quarter allocations, or 99,000 bbl. out of the 132,000 bbl., went to War Food Administration. Deputy Petroleum Administrator Ralph K. Davies, explaining this, said: "The quantity of gasoline required for nonhighway farm use always rises sharply in the second quarter to provide fuel for spring plowing, cultivating and planting."

Reflects Seasonal Demand Increase

The increases totaling 26,000 bbl. daily for Office of Civilian Requirements reflect seasonally greater demand by such industrial users of gasoline as road and building contractors, sawmills, and miscellaneous construction enterprises.

Requirements of Office of Defense Transportation, representing passenger cars, trucks, buses, and other transportation facilities, were higher than the first quarter of 1945, but lower than the second quarter of 1944, due to there being fewer cars and trucks on the road than a year ago. This agency's claims were met in full in all parts of the country except the East and West Coasts. In District 1 (East Coast), allocations were 9,000 bbl. daily lower than estimated requirements; in District 5 (West Coast), allocations were 2,000 bbl. daily lower than estimated requirements.

Bigger Output of Synthetic Rubber Vital, Says RRC

WASHINGTON. — A sharp increase in production of synthetic rubber is imperative to meet military and essential civilian transportation needs, it was announced this week by Rubber Reserve Co., subsidiary of the Reconstruction Finance Corp.

At the same time RRC reported that United States production of synthetic rubber in 1944 totaled 763,255 long tons, a figure exceeding the average annual tonnage of natural rubber consumed in this country during 1937-41.

Production scheduled for 1945 is 1,000,000 tons, or 31 per cent more than last year, and for 1946 is 1,200,000 tons, or 58 per cent above 1944 production.

1945—SECOND QUARTER AUTOMOTIVE GASOLINE ALLOCATION
(Figures in barrels daily)

	ODT	WFA	OCR	Total	Change
District 1	349,000	17,000	34,000	400,000	+ 20,000
District 2	374,000	133,000	32,000	539,000	+ 98,000
District 3	122,000	23,000	8,000	153,000	+ 4,400
District 4	27,000	9,000	2,000	38,000	+ 7,000
District 5	121,000	11,000	14,000	146,000	+ 3,000
Total U. S.	993,000	193,000	90,000	1,276,000	+132,000
Change from First Quarter	+7,000	+99,000	+26,000	+132,000	

Greater Movement of West Texas Crude to California in Prospect

WASHINGTON. — The Petroleum Administration for War is attempting to increase the movement of West Texas crude oil to California from 14,500 bbl. per day to an eventual goal of 42,000 bbl.

The immediate goal is 20,000 bbl. daily, but it is reported that there is sufficient additional refinery capacity on the Pacific Coast to handle 22,000 bbl. more, provided that transportation can be arranged.

This is in addition to the 120,000 bbl. per day of petroleum products that are moved to California ports from midwestern refineries to fulfill the steadily increasing military demands of the Pacific theater of operations.

Ralph K. Davies, deputy petroleum administrator, pointed out that the West Texas crude oil is furnished only to California refineries that have been shut down, or to those other refineries that prove they can process petroleum in addition to the crude produced along the Pacific Coast.

"At this time," Davies said, "California wells are yielding about 900,000 bbl. daily. Some of this is of such heavy viscosity that it is marketed in this raw stage as fuel oil, either with or without the addition of 'cutter stock' (gas oil which is added to reduce viscosity). The refineries of California are now refining about 840,000 bbl. daily of native crude oil.

"California fields are expected to produce about 900,000 bbl. per day, or slightly above, throughout 1945, but this quantity is far from sufficient to supply military and essential civilian demands. Nor will the 65,000 bbl. to be furnished daily by the Naval Reserve of Elk Hills make it possible to reach the goal."

West Texas crude of 30° gravity is delivered in California by the Defense Supplies Corp. at a total cost of approximately $3.35 per barrel, Davies said. It is sold to the refineries at $1.073 per barrel, with DSC absorbing the difference.

"It has been suggested," Davies said, "that the drilling of more wells be permitted in California. That would be most acceptable if manpower and materials were available, if sufficient undeveloped reserves existed, and if time permitted. It must be remembered that we need petroleum that will yield the necessary products now, and not a year or so hence."

FPC Outlines Concept of Natural-Gas Authority

WASHINGTON. — The Federal Power Commission has full authority to require reports from all gas companies transmitting gas in interstate commerce even though their actual operations may be entirely within a single state, Chairman Basil Manly asserted in an answer to a protest filed January 11 by Milo B. Maltbie, chairman of the Public Service Commission of New York.

Maltbie had complained that the FPC was exceeding its authority and introducing duplicate regulation of intrastate gas rates when it asked seven New York state companies to submit reports and accounts. Manly disclaimed any intention of regulating local rates but pointed out that all seven companies involved obtain at least part of their gas from outside the state and are therefore engaged in interstate commerce and subject to the jurisdiction of FPC. He also stated that the federal natural gas act gives both state and federal commissions concurrent jurisdiction over the accounting practices of all natural gas companies.

Army to Close Most of Its Canol Project by June 3

WASHINGTON. — Most of the U. S. Army's big Canol project in Canada will be shut down by June 3, according to a War Department statement. By that time, it was said, the Army will have stopped oil production at Norman Wells and operation of the refinery at Whitehorse and the crude-oil pipe line running to the plant from Norman Wells. These facilities, representing an investment of some $134,000,000, will be offered for sale.

The Army will retain only the products pipe line from Skagway to Whitehorse, Watson Lake and Fairbanks, Alaska. Aviation gasoline and other motor fuel will be hauled to Skagway by tanker and pumped through the pipe lines.

The joint chiefs of staff decided to abandon the project because of expected improvement in the tanker situation and the better military condition in Alaska and the Pacific.

The Army initiated the project after Japanese submarine operations and the Japanese invasion of the Aleutians threatened the flow of supplies to Alaska and Aleutians outposts early in the war. The project has been under investigation for 2 years by the Senate war investigating committee, which held that the high cost of producing and refining the petroleum made the plan impracticable.

The War Department said that American personnel and equipment would be withdrawn as quickly as possible. The shutdown will release several hundred experienced refinery men for employment in domestic refineries.

The United States will retain an option to purchase up to 60,000,000 bbl. of oil after the present operations are halted. The Army said this option is an asset for future continental defense.

The Whitehorse refinery began operation last June. Average cost of oil production was $11.15 a barrel.

Immediate Dissolution of PRC Asked by Moore

WASHINGTON.—A resolution calling for immediate dissolution and liquidation of Petroleum Reserves Corp. has been introduced in the Senate by Sen. E. H. Moore of Oklahoma, who led a similar attack on PRC in the last Congress.

Explaining the resolution to the Senate, Moore said that the asserted purpose for which PRC had been organized was to build and operate the so-called Arabian pipe line, but that the corporation is virtually dormant at present. He challenged the legality of PRC because the act under which it was chartered provides that it may not continue beyond January 22, 1947, whereas the language of its charter reflects a purpose to engage in the petroleum business as a permanent industrial program.

Senator Moore engaged in a lengthy criticism of government corporations in general, declaring they are leading to the totalitarianism of the corporate state. Regarding PRC he said: "Other than the Secretary of the Interior, who still holds the ambition of becoming the petroleum czar in the new order of American bureaucracy, I know of no one who now defends the existence of the Petroleum Reserves Corp."

A. I. M. E. Hears Discussion Of Pressure Measurements

KILGORE. — "Precision in Bottom-Hole Pressure Measurements" was discussed in a paper by E. R. Brownscombe and D. R. Conlon, of The Atlantic Refining Co., at the monthly meeting of the East Texas section, American Institute of Mining and Metallurgical Engineers, held here March 13. Brownscombe presented the paper.

Staley Joins Journal Staff; Takes Over New York Editorial Office

FABIAN R. STALEY, who has been actively connected with the refining and allied industries for more than 20 years as a chemist, engineer, and writer, effective March 16, joined the staff of The Oil and Gas Journal as associate editor in charge of the New York editorial office. He will bring to the Journal readers wide experience in the refining of petroleum products. In his new work, in addition to his reports on domestic developments, he will devote considerable time to petroleum operations outside the United States.

Staley received a degree in chemican engineering from Carnegie Institute of Techonolgy in 1920. He has taken post graduate work in chemical engineering, physical chemistry and economics at Carnegie Institute of Technology, Columbia University, and the University of Pittsburgh. He studied patent law at the graduate school of law of New York University.

From 1920 to 1925, Staley was employed as a chemical engineer at the Pittsburgh and Philadelphia refineries of the Atlantic Refining Co. During 1926-1929 he was chief chemist of the Texas Pacific Coal & Oil Co., Fort Worth. From 1929 to 1933 he was refinery editor of The Petroleum Engineer, Dallas, and was also engaged in consulting work during that period.

In 1933 Staley joined the Max B. Miller Co. as research and development engineer and carried on extensive research work in petroleum lubricants for that organization until 1941. During 1941-1942 he was connected with the Magnesol Co. as research and sales engineer. Over the past 3 years he has been engaged in war work as consulting chemical engineer for the Stupahoff Manufacturing Co., Latrobe, Pa.

FABIAN STALEY

USO Gets Another Check From Petroleum Industry

NEW YORK.—United Service Organizations, Inc., has received from Petroleum Industry War Council a check for $9,233.63, final contribution to USO from proceeds of the President's rubber drive. On May 5, 1943, PIWC, as trustee, distributed equally among Army Emergency Relief, Navy Relief Society, American Red Cross and USO $2,433,185.20. This amount represented the difference between the proceeds from scrap rubber sold to Rubber Reserve Co. at $25 a ton and the payments for rubber purchased at a penny a pound in the President's rubber drive, conducted by the petroleum industry.

In a letter to USO, Allan H. Hand, executive secretary - treasurer of PIWC, said that since the original distribution of funds further contributions had totaled $36,934.54.

Lease Sale Indicates Interest in Black Oil

DENVER.—The relative increase in importance of Wyoming black oil production in recent years is indicated in the sale of leases on the Black Mountain structure on which bids were opened the past week by the Department of the Interior. Oil in the Embar-Tensleep horizons was discovered in 1923 and subsequent development, principally by the Utah Oil Refining Co., resulted in five Tensleep and two Embar wells which had initial production of 200 to 300 bbl. each per day. The depth was around 3,100 ft. to the Tensleep. There was little demand for that type of oil at the time and the Utah company afterward turned its holdings to the Tristate Oil Co. The wells began showing water and have not been operated for some time.

The Black Mountain anticline lies on the southeastern rim of the Big Horn Basin, in Hot Springs County, Wyoming, 25 miles east of Thermopolis. The general land office offered 1,861 acres on the structure in 11 parcels. There were no bids on two parcels. The remaining nine parcels brought bonus bids aggregating $58,427.25 for 1,576 acres, an average of $37.32 an acre. High bid was $100.70 an acre. Texas Co. was high bidder on eight tracts comprising 1,415 acres, and J. G. Dyer, of Denver, acquired one parcel of 160 acres. The 1923 discovery well was in SW NW 36-43n-91w. The Dyer parcel is in Section 35. The Texas Co. tracts are in Sections 5 and 6-42-90; 31 and 32-43-90; and 25 and 26-43-91.

Postwar Chemical Strides By Phillips Foreshadowed

Plans for important postwar strides in the field of chemicals are indicated in the annual report March 15 of Phillips Petroleum Co. and its subsidiaries. Development of chemicals and special hydrocarbons expanded during 1944, largely to meet war's demands, but the research and experience involved, along with raw materials required, have provided the essentials for a widely diversified chemical production in the future.

The company's large new laboratory and its associated pilot-plant installations at Phillips, Tex., are designed for research relating to rubber, carbon black and chemicals. Several other units of this kind were moved to Phillips from other locations, thus providing the nucleus for a large-scale chemical development at the sources of raw materials, fuel, and other utilities, with ample research facilities always available.

Five Pipe-Line Companies Freed of Fraud Charges

Litigation extending over more than 8 years ended last week, when Judge Royce H. Savage, sitting in Federal Court, Tulsa, dismissed suits against five pipe-line companies which alleged fraud in the measurement of oil produced in the Osage country and moved through lines operated by the defendants.

The companies involved were Stanolind Pipe Line Co., Oklahoma Pipe Line Co., Texas Pipe Line Co., Gulf Refining Co. and Cosden Pipe Line Co..

The action by the Government to collect "upwards of $40,000,000 from the oil purchasers and transporters" in behalf of the Osage Indian tribe was instituted December 31, 1936, when fraud was alleged in connection with the oil industry's custom of making a 3 per cent deduction on transportation of oil through pipe lines.

THIS WEEK

HALT— War Department announces abandonment of $134,000,000 Canol project. . . . Says Army recommends it because of expected improvement in tanker situation. . . . Insists that at time project was conceived it was a justifiable attempt to make Alaska self-sufficient in oil. . . . Facilities to be sold. . . . ¶Moore introduces resolution in U. S. Senate demanding immediate dissolution of PRC. . . .

PRODUCTION—Severity of shortage in crude and of materials will increase if war continues, PAW tells production committee of PIWC. . . . Crude requirements will outrun production, necessitating increased imports. . . . ¶January saw 522 geophysical and 50 core-drill crews working—all time high. . . . ¶Materials situation worse than 2 months ago. . . . ¶Nation's daily crude production up 7,050 bbl. . . . Kansas and Texas biggest contributors to week's rise. . . . Illinois, Kentucky and Mississippi off.

TIRES—ODT issues warning to retread and repair every worn and usable tire to avoid "serious breakdown in rubber-borne transportation." . . . Deficit in all types of tires. . . . ¶Shortage of carbon black chief obstacle to production of tires and other rubber goods. . . .

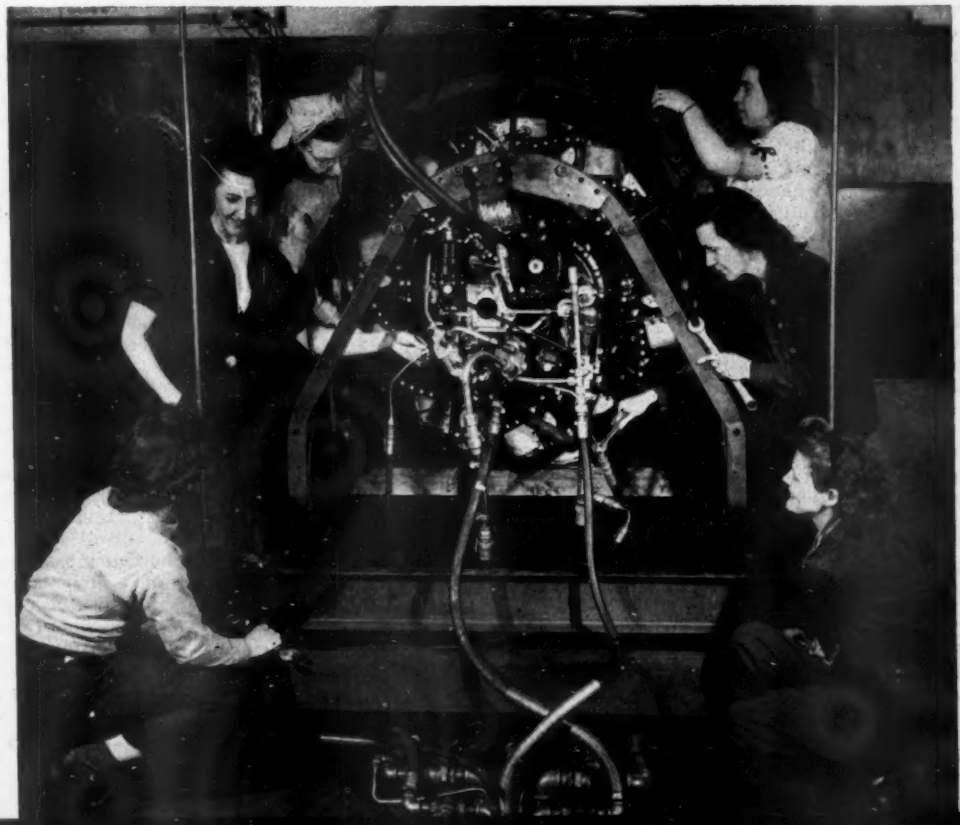
NATURAL GAS—Olin Culberson, chairman Texas Railroad Commission, declares he'll fight effort to export gas from his state to Ohio even if other members of commission refuse to join him. . . . ¶Sinclair to build plant for casinghead-gasoline recovery and pressure maintenance in Monagas, Venezuela. . . . Estimated cost $2,500,000. . . .

FORESIGHT—Refiners preparing for postwar operations. . . . Phillips has nucleus for large-scale chemical production at sources of raw material, fuel and other utilities. . . . New laboratory designed for research in carbon black, rubber, chemicals. . . . ¶Pure to build plant for manufacture of lubricating oils and greases from crudes of special quality. . . . New carbon-disulfide plant will increase volume and variety of chemicals recoverable from byproduct gases. . . .

DRILLING—Texas recaptures world's deep-well record with Phillips' 3 Schorp, Brazoria County, now below 16,300 ft. . . . Former record held by Standard of California in Kern County, California, at 16,246 ft. . . . Phillips test expected to pass 17,000 ft. . . .

REFINING—PAW says midwestern refiners who have been receiving crude from other operators under sharing program must exhaust all resources for getting their own crude before asking help in future. . . . ¶Second-quarter allocation of automotive gasoline for civilians 1,276,000 bbl. daily. . . . Increase of 132,000 bbl. over first quarter designed to meet seasonal demand. . . .

COURTS—Five pipe-line companies cleared of fraud charge in measurement of oil produced in Osage country and handled through their lines. . . . Dismissal asked by government attorney. . . . Ends 8-year litigation. . . . ¶OPA files suits against five companies in Chicago district, alleging improper pricing programs. . . . Companies say charges result from uncertainty over meaning of regulations, not from intent to evade. . . .



The newest of airplane engines, the G.E. jet, being connected for test at the Lynn, Mass., plant of General Electric. Girls have proven particularly efficient in this type of war work. This is the first picture to be released with approval of the War Department, showing the turbo-jet. G.E. is building turbo jets for the P-80 Shooting Star, recently announced by the War Department as the world's fastest fighter plane. Fuel for the new jet engine, generally meeting kerosene specifications, may become the oil industry's next major war problem

Important Developments in Rockies Center Around Four Great Basins

by Charles J. Deegan

This, the second article of three, discusses recent discoveries in the Rocky Mountains, giving detailed data on the location, geology, probable reserves, reservoir conditions, and quality and price of the oil.

THERE are two distinct phases of the exploration campaign in the Rocky Mountain region. One is directed toward the future, the geological-geophysical search for concealed structural prospects in the interior of the sedimentary basins. The second, the actual discoveries and developments of the past 3 years, is important now.

Although exploration and development campaigns have been carried on throughout the entire region, the most important results have been largely confined to an area comprising Wyoming and northern Colorado. The accompanying Table 1 lists the fields and pays in that area in which either new discoveries, extensions, or important developments have taken place during 1942, 1943 and 1944. These same fields and their relationship to the regional geology are also shown on a map. (Fig. 1, page 60.)

For convenience in referring from the tabulation to the map, the data on fields are listed in alphabetical order by fields, under the name of the basin in which the field is located. This arrangement brings out the fact that most of the important strikes of the past 3 years lie in a north-south area that might be described as the east half of the west half of Wyoming, plus an extension of that area into northern Colorado.

Classifying the fields by basins also shows that the most important developments have been in rim structures around four great basins: (1) Big Horn, (2) Wind River-Shirley, (3) Washakie, and (4) Uinta. Three minor discoveries, at least according to present indications, are one in the Powder River basin, one in the Denver basin, both in Wyoming, and one, North McCallum, in the North Park area of Colorado.

Local Structure

As shown in the table and map, all the recent discoveries and extensions are on local structures. In the entire Rocky Mountain area only two fields are classified as stratigraphic traps, neither of them a recent discovery. These are Cut Bank, in Montana, and Osage, in Weston County, northeastern Wyoming. The Kevin-Sunburst field, in Montana, is sometimes classified as a stratigraphic trap insofar as oil accumulation is concerned, although it is located on a very large dome.

However, not all local structures produce oil. This appears to be just as true today as it has been throughout Rocky Mountain oil history. Why some structures produce oil and others do not is still an unsolved question. The only definite progress that has been made is negative; i.e., some of the previous theories are now known to be wrong. Once it was thought that only unfaulted structures would produce oil. Now it appears that faulted structures, if anything, produce larger fields than unfaulted ones. The old flushing theory, in which it was postulated that the oil had been flushed out of many of the structures by water, has been abandoned by many geologists and has heavy going in the face of more recent evidence.

The flushing theory got most of its support from the relative lack of salinity of the connate waters in most Rocky Mountain structures. However, in the face of discoveries of oil on structures much lower than dry structures adjacent, flushing is difficult to support. Moreover, now that permeability and porosity examinations are frequent, it develops that most Rocky Mountain formations have very low permeabilities.

Even when oil is found on a local structure in this region it is almost certain that only part of the area within the closing contours of the local structure will produce. Most of the recent developments still follow this pattern, as will be noted by comparing Cols. 2 and 5 in Table 1. The best available information indicates that only one structure in the Rocky Mountains, Salt Creek, has been filled with oil down to the closing contour. Even in Salt Creek this was true of only one sand, the Second Wall Creek, although the field produced from seven sands, plus some oil from the shale above the First Wall Creek sand.

Thus far, no consistent structural pattern appears noticeable among the recent discoveries, at least to the local geologists. Many steeply folded structures produce; others do not. Sometimes less sharply folded structures produce; sometimes they are dry. If a structure produces in a shallow formation, it has a better chance of producing in a deeper formation than one that is dry in the shallow. Sometimes the deeper sands will be saturated over more area than the shallower producing sands; sometimes the reverse is true.

In considering structural conditions the data in Fig. 1 on area and closure of surface structures are relatively accurate for purposes of general comparison and should be useful as such. Limitations will be recognized by all geologists familiar with the region.

Although the Steamboat Butte structure, in Fremont County, and the Bailey dome, in Carbon County, were seismographed before drilling, substantial but incomplete surface indications were evident and have been noted for many years. Therefore, without in any way detracting from the credit due to geophysics for working out these structures, they are considered to be a part of the rim surface structure group of fields, to distinguish them from the hidden, inner basin structures, which are the objective of most of the current geophysical work.

Producing Formations—Reserves

With one important exception, the Rangely field, in the Uinta basin of Colorado, the bulk of the oil found in recent developments is Embar-Tensleep. At Rangely the new oil is coming from the Weber, of Pennsylvanian age. The Embar is a lime, the Tensleep a sand; and in northern Wyoming, particularly in the Big Horn basin, the Tensleep usually lies immediately below the Embar. The oil is quite often identical in character and probably from the same source, regardless of whether found in Tensleep or Embar. Some Madison lime (Mississippian) oil has also been found.

At this stage it is difficult to esti-

(Continued on page 63)

FOUNDED IN 1910

BY PATRICK C. BOYLE

the OIL AND GAS JOURNAL

Tax Inequalities

THE inequalities of our wartime taxing program in relation to petroleum activities have been brought home forcefully again over the past month as operators made their final income-tax payments and attempted to correlate 1945 and later operations with expected net returns.

There is no disposition to complain regarding tax burdens as they affect the normal living of individuals. It is realized that no reduction in the personal income of civilians imposes too great a sacrifice under war conditions. Such sacrifice is small compared with that made by more than 11 million men and women in our armed forces. But our emergency taxes, which have been in effect longer than expected when they were inaugurated 3 years ago, go deeper than their immediate effect on standards of living among those who have remained on the home front.

The oil industry is an outstanding example of the dangers inherent in existing tax laws in relation to wartime and postwar industrial operations. This business consists of thousands of operators, with investments which range from a few thousand to several hundred million dollars. In prewar days taxes were applied so that no group enjoyed a tax advantage that became a controlling factor in operating policies.

It is apparent that this normal and sound situation does not exist now. The unwanted condition usually pointed to has to do with exploration costs. Those activities which are financed from what would otherwise be taxed as excess profits are paid for at a small fraction of the net cost to operators who have had normal, less than normal, or no profits.

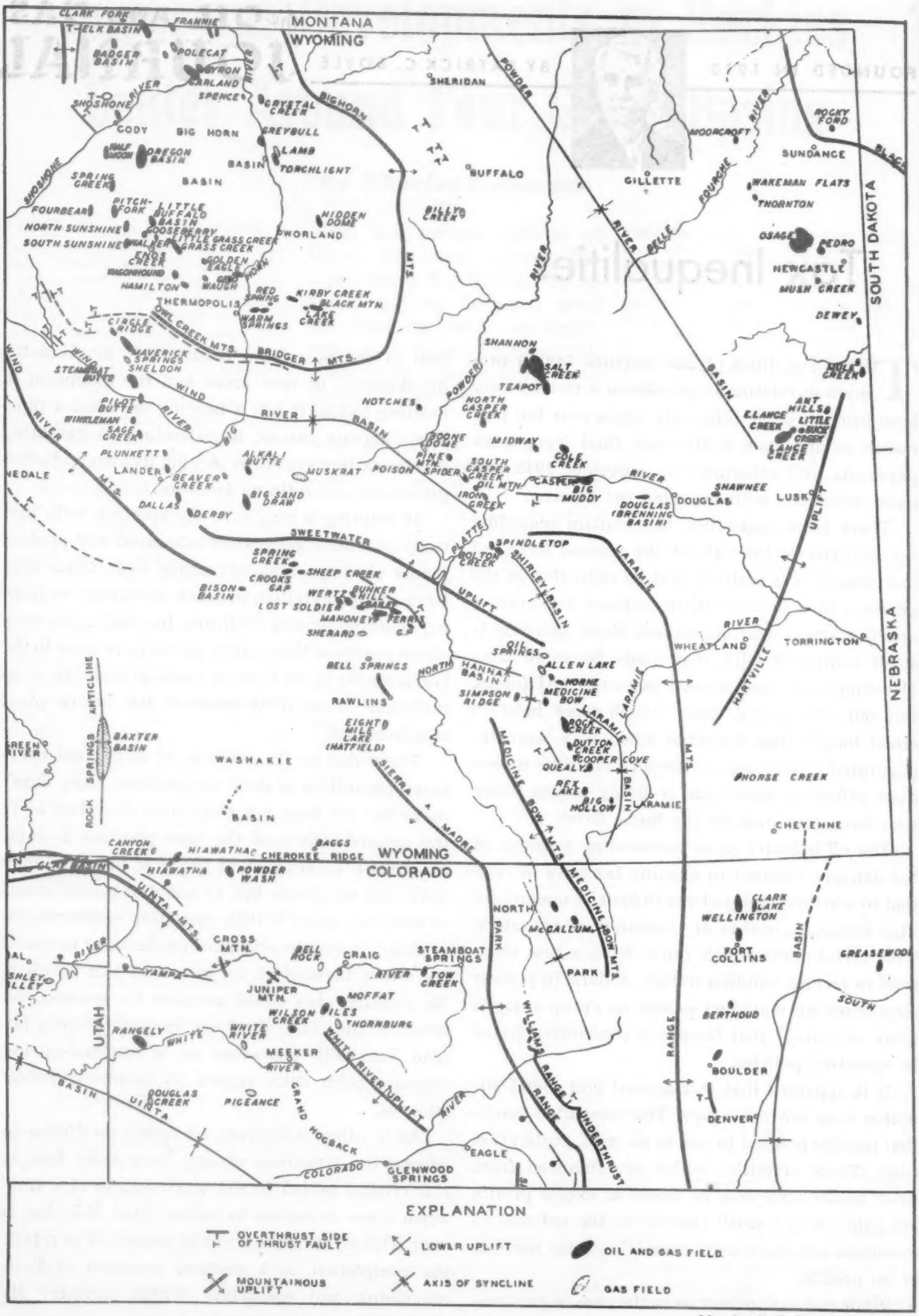
While not as apparent as in the case of exploration, these tax disparities carry on into every division of the petroleum industry. It involves the development of new areas and the extension of existing fields. It has a bearing on what a pipeline company can do in extending its gathering and trunk-line system in serving its own and other producing and refining facilities.

In refining it may give the operator with partially or wholly government-financed war-product plants an important advantage over those who have supplied civilian products involving no large expenditures in new facilities. In many cases most of the profits of these latter plants have gone to the Government in the form of taxes, preventing accumulation of adequate reserves for future plant requirements.

There can be no criticism of individual operators, regardless of their tax position. They didn't make the tax laws nor were they consulted as to the assured effects of the laws previous to their enactment. In support of the war program they have had no choice but to adapt the regulations as best they could to their operating requirements.

Adjustments in prices for crude oil or products are not of themselves an answer to this problem. No subsidy plan could possibly be worked out which would offset the basic inequalities of a tax plan hurriedly conceived as a revenue-raising measure with little regard to economic consequences.

As in other industries, oil operators dislike to expose the weakness of any emergency law at this critical period in the war's course at a time when there is reason to believe that V-E day is near. This attitude must not be permitted to retard the completion of a postwar program of both decreasing and equalizing within industry its share of future taxes.



Map by C. E. Dobbin, U.S.G.S.

Fig. 1—Oil and gas fields of Wyoming and northern Colorado, showing main structural features

Developments in Rocky Mountain Area

(Continued from page 58)

mate what reserves underlie the various discoveries. Nevertheless, in an attempt to give some kind of relatively useful yardstick, estimates have been obtained from various sources and incorporated in Table 1.

The kind of estimates sought were not "proven reserves," but what a given field might reasonably be expected to produce if it were an average of its type—size, closure, producing formation and known sand conditions considered. It is doubtful if this goal was achieved, particularly in the fields where only a few wells have been drilled. Some of the estimates are possibly a little more liberal than might be considered "proven reserves," but with few exceptions, they are probably conservative estimates.

In general, the larger the surface structure, the larger the productive acreage in the oil-producing formation. Therefore, it is not surprising that Elk Basin, Oregon Basin and Rangely should show up as the largest fields from the standpoint of reserves. (See Col. 6, Table 1.) On the other hand, Lost Soldier, although one of the smaller-sized structures, is definitely one of the richer fields, whereas Little Buffalo Basin, a large structure, is thus far a disappointment. Powder Wash, a medium-sized structure, differs in magnitude of folding from the others, but being a Tertiary surface structure, producing from the Wasatch, which is

TABLE 1—ROCKY MOUNTAIN DISCOVERY SUMMARY, 1942-44, INCLUSIVE

(All Wyoming except three in Colorado)

	Surface structure			Pot. reserve discovered			Prod. sand information				Crude oil		
		Area in	Closure	Name of	Probable acreage	Probable bbl. (millions)	Avg. depth	Est. total thickness (ft.)	Est. porosity (%)	Best permeability (md.)	Price	Gravity, °A.P.I.	Per cent sulfur
Field and county—	Location 1	acres 2	in feet 3	formation 4	5	6	7	8	9	10	11	12	13
BIG HORN BASIN													
Elk Basin, Park	57n- 99w	20,000	3,500	Tensleep	6,000	200	5,000	150	22	350	0.90	30	2.01
Four Bear, Park	48n-103w	1,100	500	Tensleep	400	3	3,300	50	(§)	(§)	(§)	14	(§)
Frannie, Park	58n- 98w	1,600	800	Tensleep	700	14	3,200	50	21	400	0.85	28	2.36
				Madison	200	1	3,100	(§)	20	200	0.62	17	3.07
Garland, Park	55n- 97w	15,000	2,600	Tensleep	1,700)	15	(4,500	150	22	400	0.60	21	2.55
				Madison	2,000)		(4,300	60	(§)	(§)	0.60	21	3.27
Gebo, Hot Springs	44n- 95w	1,200	450	Embar	300	4	4,700	275	12	1	0.90	29	1.98
				Tensleep	300	2	4,950	200	12	50	0.85	24	2.64
Golden Eagle, Hot Springs	45n- 97w	1,300	350	Muddy	300	1	6,700	40	(§)	(§)	(§)	59	(§)
				Dakota	(§)	(§)	7,200	(§)	(§)	(§)	(§)	52	(§)
Half Moon, Park	51n-102w	2,000	700	Emb.-Tens.	300	2	3,200	75	(§)	(§)	(§)	15	3.98
Kirby Creek, Hot Springs	43n- 92w	2,500	600	Embar	350	2	3,600	10	(§)	(§)	(§)	21	3.29
Little Buffalo Basin, Park	47n- 99w	15,000	1,600	Tensleep	1,000	2	4,800	200	18	200	0.75	20	3.37
Oregon Basin, Park	51n-101w	8,000	1,000	Embar)	7,000	100	(3,400	150	16	1	0.61	23	2.91
				Tensleep)			(3,600	75	(§)	(§)	0.65	23	2.77
				Madison	1,200	6	4,500	250	15	5	0.65	17	3.68
Pitchfork, Park	43n-102w	3,200	2,000	Tensleep	400	2	3,900	175	(§)	(§)	(§)	19	3.64
Wagonhound, Hot Springs	44n- 98w	800	400	Embar	500	4	4,300	50	(§)	(§)	(§)	29	1.38
WIND RIVER-SHIRLEY BASINS													
Big Sand Draw, Fremont	32n- 95w	*2,500	1,500	Embar)	1,500	60	(6,900	350	(§)	(§)	0.84	32	(§)
				Tensleep)			(7,500	300	16	120	0.90	35	1.39
Pilot Butte, Fremont	3n- 1w	2,600	1,000	Embar)	160	3	(6,000	50	22	20	0.80	28	2.02
				Tensleep)			(6,200	(§)	16	90	0.80	26	2.34
Spindletop, Natrona	30n- 81w	1,500	1,000	Tensleep	300	2	2,300	100	25	1,000	0.65	18	3.34
Steamboat Butte, Fremont	4n- 1w	†2,600	700	Lakota	80	0.2	4,500	50	17	(§)	1.21	38	0.02
				Sundance	250	5	5,200	130	18	200	0.85	28	2.53
				Tensleep	800	10	6,900	200	13	300	0.85	30	2.18
Winkleman, Fremont	2n- 1w	420	300	Tensleep	200	3	2,900	300	19	200	0.80	24	2.90
WASHAKIE BASIN													
Bailey Dome, Carbon	26n- 89w	‡400	175	Sundance	300	5	5,200	30	(§)	(§)	1.08	34	0.39
Crook's Gap, Fremont	28n- 92w	2,500±	3,000	Lakota	600	10	5,200	25	(§)	(§)	1.18	39	0.18
Lost Soldier, Sweetwater	26n- 90w	2,600	3,500	Tensleep	1,300	80	5,000	350	14	25	1.00	34	1.2
Powder Wash, Moffat (Colo.)	12n- 97w	4,100	80	Wasatch	400	3	4,600	Lenses	28	(§)	(§)	38	0.1
UINTA BASIN													
Rangely, Rio Blanco (Colo.)	2n-103w	55,000	1,600	Weber	6,000	60	5,800	500	12	Low	0.97	32	0.68
POWDER RIVER BASIN													
East Lance Creek, Niobrara	36n- 64w	1,500	170	Dakota	400	1	4,000	60	23	400	1.25	44	(§)
Little Buck Creek, Niobrara	36n- 64w	200	125	Dakota	40	0.1	3,800	25	15	150	1.25	42	(§)
Mush Creek, Weston	44n- 63w	Terrace		Muddy	100	0.5	3,800	5	(§)	(§)	(§)	37	<0.10
MISCELLANEOUS													
Cooper Cove, Carbon	18n- 77w	250	200	Dakota	80	0.4	4,700	50	(§)	(§)	1.11	33	0.32
Horse Creek, Laramie	17n- 68w	5,000	1,800	Muddy)	200	1	(5,400)	40	(15	1	1.11	33	0.31
				Lakota)			(5,500)		(20	100	1.05	30	<0.10
N. McCallum, Jackson (Colo.)	9n- 79w	1,500	1,000	Dakota	1,400	4	5,300	(§)	17	150	1.25	52	<0.10

*On Frontier sand. †On Muddy sand. ‡Seismic. §Unavailable.

Eocene Tertiary, it belongs in a classification by itself.

Sand Conditions

From the standpoint of sand thickness, the Embar, Tensleep and Madison leave little to be desired, as the data in Col. 8, Table 1, indicate clearly. When it comes to porosity and permeability, as Cols. 9 and 10 reveal, it is an entirely different story. In the Embar and Madison, both limestones, the production seems to come almost entirely from cracks and crevices, permeabilities in the rest of the lime ranging from practically nil to only a few millidarcys. The one exception is Frannie, where the Madison shows as high as 200 millidarcys in one of the best pay streaks.

The permeability of most formations in the Rocky Mountain is low, and generally, the older the rocks, the lower the permeabilities seem to be. The data shown in Col. 10, Fig. 1, apply only to the best and most prolific pay streaks in the various fields listed. It is not an average of the entire formation, since such data on a comparable basis are not available for most of the fields. There are, however, sufficient data to state definitely that most of the formation thickness, particularly in the Tensleep sand, will average substantially lower in permeability than the richer pay streaks.

Quality and Price of Crude

Crudes are generally called "light" or "black" in the Rocky Mountain district, meaning that they are either medium to high-gravity, sweet crudes, or low-gravity, high-sulfur-content oils. It will be evident from the data in Cols. 11, 12 and 13, Table 1, that much of the new oil is black oil of low gravity, high sulfur content, with a correspondingly low posted price. There is a noticeable tendency for the Paleozoic oils in the northern part of Wyoming to be lower in gravity and higher in sulfur content than in the southern part of Wyoming and in Colorado. The Cretaceous formations almost invariably produce light, sweet crude, and the Tertiary crudes found to date are usually light and sweet.

The present prices for black oil may appear low, but they are the highest that have prevailed for a good many years, due to wartime demands for fuel oil. When no posted price is indicated in Col. 11, it means that either no crude is being marketed yet, or, more likely, that the crude is being trucked from a field that has no pipe-line outlet.

In the prewar period black oil was a drug on the market and there was no incentive to develop additional production since a substantial potential production of this type was shut in. After the present wartime demand for fuel oil ceases, many informed people think that refiners familiar with the characteristics and possibilities of black oil will find the price differential sufficiently attractive to develop special processes that will assure a continued postwar market, perhaps at even higher prices than those now prevailing.

Subsidy Authorization Is $290,000,000

WASHINGTON. — Subsidies totaling $290,000,000 for petroleum transportation and stripper-well-premium prices are authorized to be paid by the Defense Supplies Corp. during the fiscal year ending June 30, 1946, under the terms of a bill favorably reported by the Senate committee on banking and currency.

Legislation is necessary because of a provision added to the stabilization act last year preventing the Reconstruction Finance Corp. or its subsidiaries from paying subsidies or buying commodities for resale at a loss for the purpose of maintaining price ceilings after June 30, 1945, except as specifically authorized by Congress.

The bill places an over-all limitation of $1,468,000,000 on all such subsidies, itemized by commodities, but provides that the unexpected balance of any kind may be transferred to another fund up to 10 per cent of the original allocation. The bill also permits payments after June 30, 1945, to fulfill obligations incurred prior to that date.

The estimate for petroleum subsidies is some $100,000,000 above the present year's program due to the stripper-well plan and increased rail movements of oil to the Pacific Coast.

ODT Gives Green Light to West Coast API Division

LOS ANGELES.—With sanction of Office of Defense Transportation, plans are being completed for the wartime conference of American Petroleum Institute, Pacific Coast District, Division of Production, to be held March 29 in the Biltmore Hotel, Los Angeles.

Speakers and subjects tentatively scheduled include: "California's New World Record Hole," by Omar A. Cavins, Standard Oil Co. of California; "Oil Well Casing Tests," by F. R. Schmeider and R. F. Kettenburg, Shell Oil Co., Inc.; "Reservoir Fluid Flow Research," by Norris Johnston, General Petroleum Corp., and N. Van Wingan, Richfield Oil Corp.; "Field Testing of Drilling Fluids," by Vernon B. Zacker, Tide Water Associated Oil Co.; "Viscosity Tests on Heavy Crude," by Richard Zinzer, Union Oil Co. of California; "Gas Lift Through Small Tubing," by A. T. Tutschulte, Tide Water Associated Oil Co. Other papers are being assigned.

Butler Elected Director By Carter Stockholders

F. W. Butler, vice president and general sales manager for The Carter Oil Co., Tulsa, was elected a director at the company's annual meeting in Tulsa, March 13. Butler joined Carter in 1944, leaving an executive position in the Standard Oil Co. of Louisiana he had held since 1931.

DEATHS

Clyde R. Minor, 64, vice president of Gulf Refining Co. until his retirement in 1940, died March 4 at his home, Cedarcroft plantation, near Greenwood, La.

Thomas E. Smith, 52, oil operator of Liberty, Tex., died February 22.

Walter James Sheehan, 62, Tulsa, associated with his brothers, John B. and Frank M., in Sheehan Pipe Line Construction Co., was killed in an explosion at Lawrenceville, Ill., March 10. He was a native of Bradford, Pa., and moved to Tulsa in 1931. He was in charge of mechanical equipment for the Sheehan company and was repairing an automobile gasoline tank when the explosion caused his death.

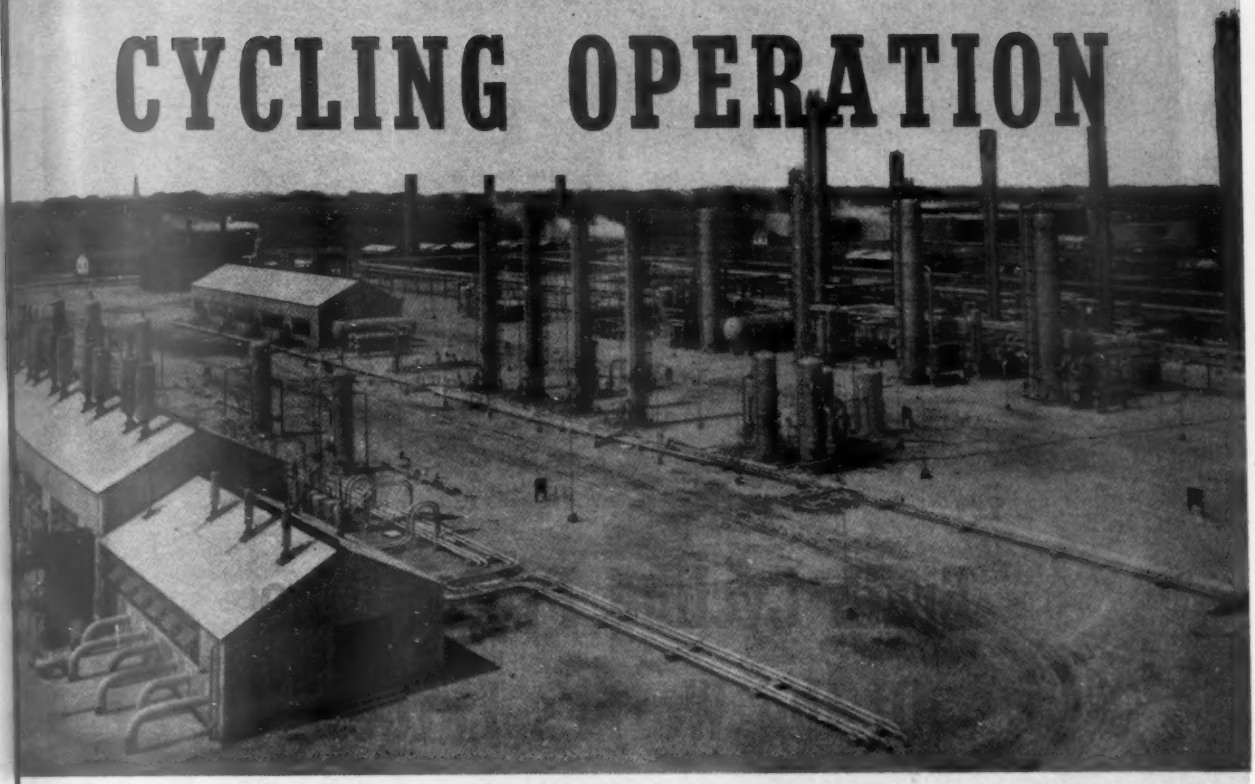
Charles Kier Davis, 60, president of Athey Truss & Wheel Co., Chicago, died of injuries suffered in an automobile accident.

Robert J. Black, assistant refineries manager for Sinclair Refining Co., died March 3 of a heart attack while returning to his home in East Chicago, Ind., from a tour of inspection of refineries in Kansas and Missouri. Black entered the oil business in 1900 as a clerk for Standard Oil Co. of Kansas, in Neodesha, Kans. He was made a stillman of the refinery there, then night superintendent and assistant superintendent before joining Sinclair in 1916. He was a director of the Indiana State Chamber of Commerce.

A. E. Ralston, 54, vice president and sales manager of Pan American Petroleum Corp., died March 10 in New Orleans.

Leonard S. Copelin, 57, active in oil developments of southern California, died in Los Angeles. Among his inventions was the Copelin core drill.

ERATH CYCLING OPERATION



A Special SECTION of THE OIL AND GAS JOURNAL

THE PROJECT

The Erath field, situated in Vermilion Parish in South Central Louisiana, is one of the major gas-condensate reserves of the Gulf Coast area of Louisiana and Texas. It is a large domal uplift and is regarded as a deep-seated or nonpiercement salt dome.

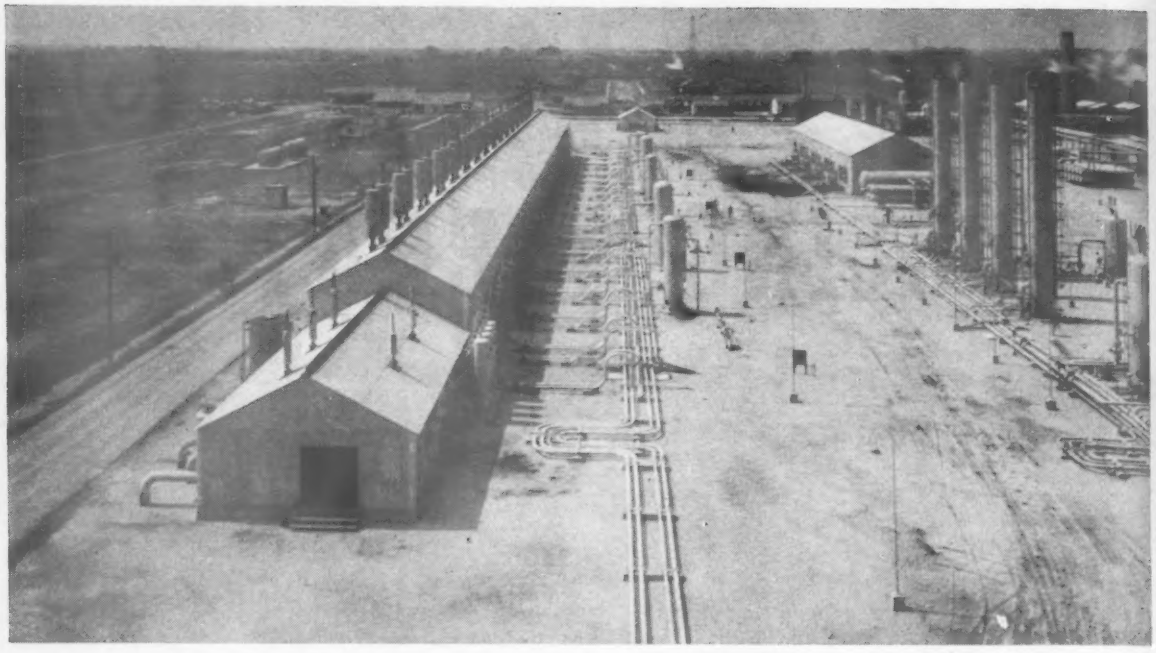
No structural expression of the uplift exists on the surface of the low-lying plain which ranges in elevation from 6 to 10 ft. above sea level.

Gas-condensate saturation is known to exist in 19 separate sands of Miocene age ranging in depth from 8,100 to 12,000 ft. These reservoirs range in size from an estimated 40 acres to 3,000 acres and in magnitude from 380 acre-ft. to 202,000 acre-ft., respectively. Maximum net sand thickness for individual sands ranges from 7 to 178 ft.

The presence of the structure was detected by seismograph surveys by several companies. The discovery well was The Texas Co. 1 Parish School Board in SE 16-13s-4e, completed in April 1940.

Following drilling of nine wells, unitization of the entire field was undertaken late in 1941, and finally consummated about 1 year later, with The Texas Co. as operator, and Phillips Petroleum Co., Tide Water Associated Oil Co., and others participating.

Construction of a 200,000,000-cu. ft. cycling plant was started in November 1942, and placed in operation in April 1944. This plant, the first large installation with high injection pressure (4,600-4,700 p.s.i.) utilizes 12,800 compressor hp. and has a total of 18,600 hp. in prime movers.



Compressor building, looking south from cooling tower, showing suction and discharge manifolding

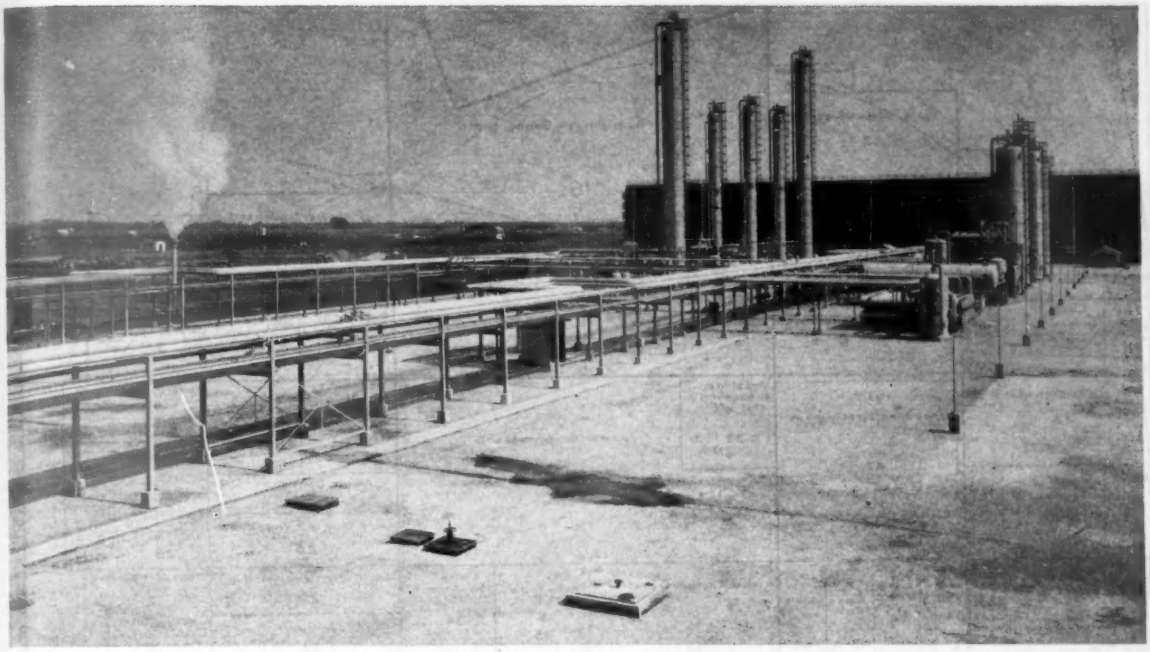
Erath Cycling Project One Of the World's Largest

Interior view of compressor building

THE Erath field is located in the west central part of Township 13s-4e, in the eastern part of Vermilion Parish, Louisiana, (Fig. 1). It is approximately 4 miles south of Erath, a sugar-mill town, located on State Highway 25, and on a branch of the Southern Pacific Railroad extending from Gueydan to New Iberia. It is 10 miles southeast of Abbeville, parish seat of Vermilion Parish. Water transportation is afforded by Vermilion Bayou, approximately 5 miles to the west, and by the Intracoastal Canal, approximately 7 miles to the south. Texas Pipe Line Co.'s oil pipe line from Paradis, La., to Port Arthur, Tex., serves the field.

Physiography

The Erath field is in the Gulf Coastal plain which locally has a surface elevation ranging from 6 to 10 ft. above sea level. The Erath structure has no surface expression. The higher and better-drained areas are suitable for rice and sugar cultivation. Toward the south, the terrain is lower and grades into marsh land where muskrat trapping is the chief industry. The area drains to



View of fractionating and still group

Vermilion Bay on the south and to Vermilion Bayou on the west.

Geology

The field is on the west flank of the Mississippi Valley syncline in which a thick series of sediments were deposited during late Mesozoic and Cenozoic time. This synclinal trough plunged southward, and, consequently, there is a rapid thickening of these beds from north to south. While any estimate of the thickness of these sediments is speculative, it is believed that the Mesozoic and Cenozoic sedimentaries in this area are more than 30,000 ft. thick. The regional dip in this area is approximately south-southeast.

The structure is concealed by Pleistocene and Recent deposits, and, therefore, all conclusions and impressions are based upon the study of the electric logs, wire-line core, and cuttings. These core data are quite extensive since nearly all of the major producing sands were cored in most of the 18 recently drilled wells.

The Tertiary section consists mainly of soft to firm, thick sand bodies separated by shale beds. All of the producing sands at Erath are Miocene in age. The Oligocene was not reached in the deepest well at a depth of 12,033 ft., and it is believed that it will not be reached above 12,500 ft. on top of the dome.

Stratigraphy

Pleistocene-Pliocene:

1. Surface to approximately 1,000 ft: This member is composed of lenticular beds of clay and coarse sands and gravels with some shell beds. The sands and gravels carry fresh and brackish water as shown by the electric logs.

2. One thousand feet to approximately 1,500 ft.: A series of shales and sandy shales with a few thin gravel beds and shell beds comprise this member.

Pliocene:

One thousand five hundred feet to approximately 5,000 ft.: Alternating thin beds of coarse to medium grained sands and sandy shales with a few thick beds of sand make up most of this section.

Miocene:

1. Five thousand feet to approximately 6,500 ft.: Interbedded fine

Three 400-hp. boilers, and furnace stacks in background

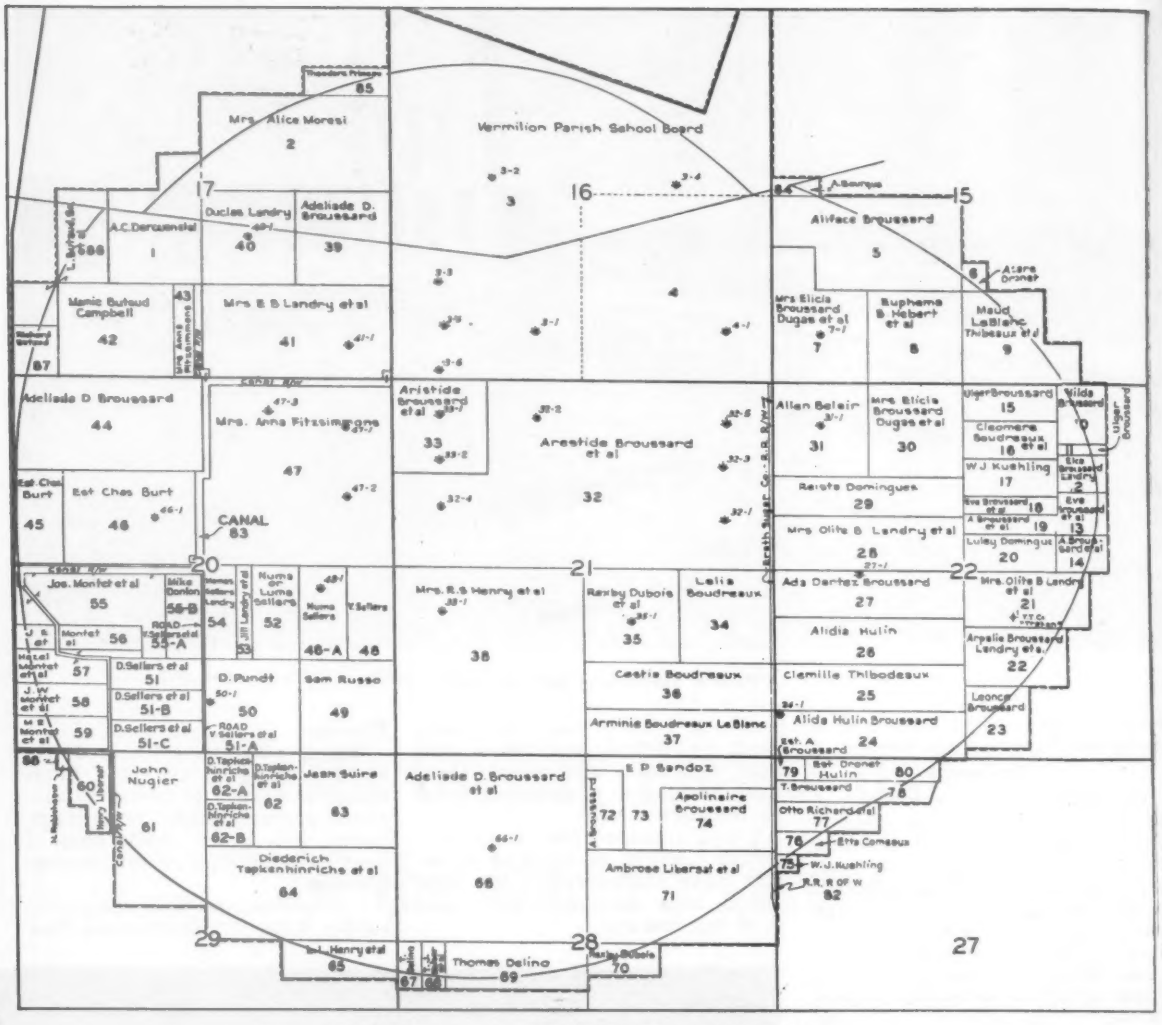


Fig. 1: Unit area, Erath field, Vermilion Parish, Louisiana

to medium grained, gray sand, gray sandy shale, and brittle shales comprise this interval.

2. Six thousand five hundred feet to approximately 7,000 ft.: This member consists principally of gray shale interbedded with sandy shale.

3. Seven thousand feet to 12,033 ft. (depth of deepest well at Erath): This interval is composed predominantly of thick sand bodies separated by thin beds of dark gray, poker-chip shale. These shale beds are thicker and more common in the lower part of the section. The sands are light gray in color and vary from fine-grained, ashy sands to clean, fine-grained to medium-grained sand. They are composed mainly of subangular quartz grains with minor amounts of dark mafic minerals such as amphiboles and pyrozenes, also mica and volcanic ash. The sands are fairly well consolidated and usually have high porosities and permeabilities. Thin beds of shells and lignite are quite common in some parts.

Structure

The field is on a distinctly domal uplift affecting an area approximately 5 miles in diameter. The structural influence of the dome is shown by seismic surveys to extend from 2 to 3 miles north of the center of the uplift, located in the NW cor. Section 21. The other limits are more obscure because the structure blends into normal south-southeast dip on these sides.

The dome probably was caused by a deep-seated salt plug. The absence of any gravity expression of the dome is unique as most Gulf Coast domes are associated with a gravity minimum, while a gravity maximum is found over domes having a thick, shallow cap rock. The lack of a gravity feature at Erath may be due to a higher density of the sediments overlying the salt, which compensates for the minimum effect of the salt.

A southward-dipping fault crosses the north side of the field, forming a wide angle "V" with the apex in the south-central part of Section 16. This is the only fault found in the field, a rather unusual condition for Gulf Coast domes of this magnitude. The intersection of the fault plane with the 10,400-ft. and deeper sands determines their northern limits of saturation. Accumulations in the upper sands do not extend to the fault. The dip of the fault plane approximates 57°. The displacement varies from 325 ft. in well No. 40-1 on the northwest flank of the field to 400 ft. in No. 3-4 on the northeast flank.

Closure at 10,000 ft. amounts to at least 250 ft. in the segment north of the fault. South of the fault, a closure of about 350 ft. is indicated and relief increases with depth, giving progressively more closure on deeper sands and less closure on the shallower sands.

Exploitation

Development prior to unitization.—The discovery well of the Erath field was The Texas Co. 1

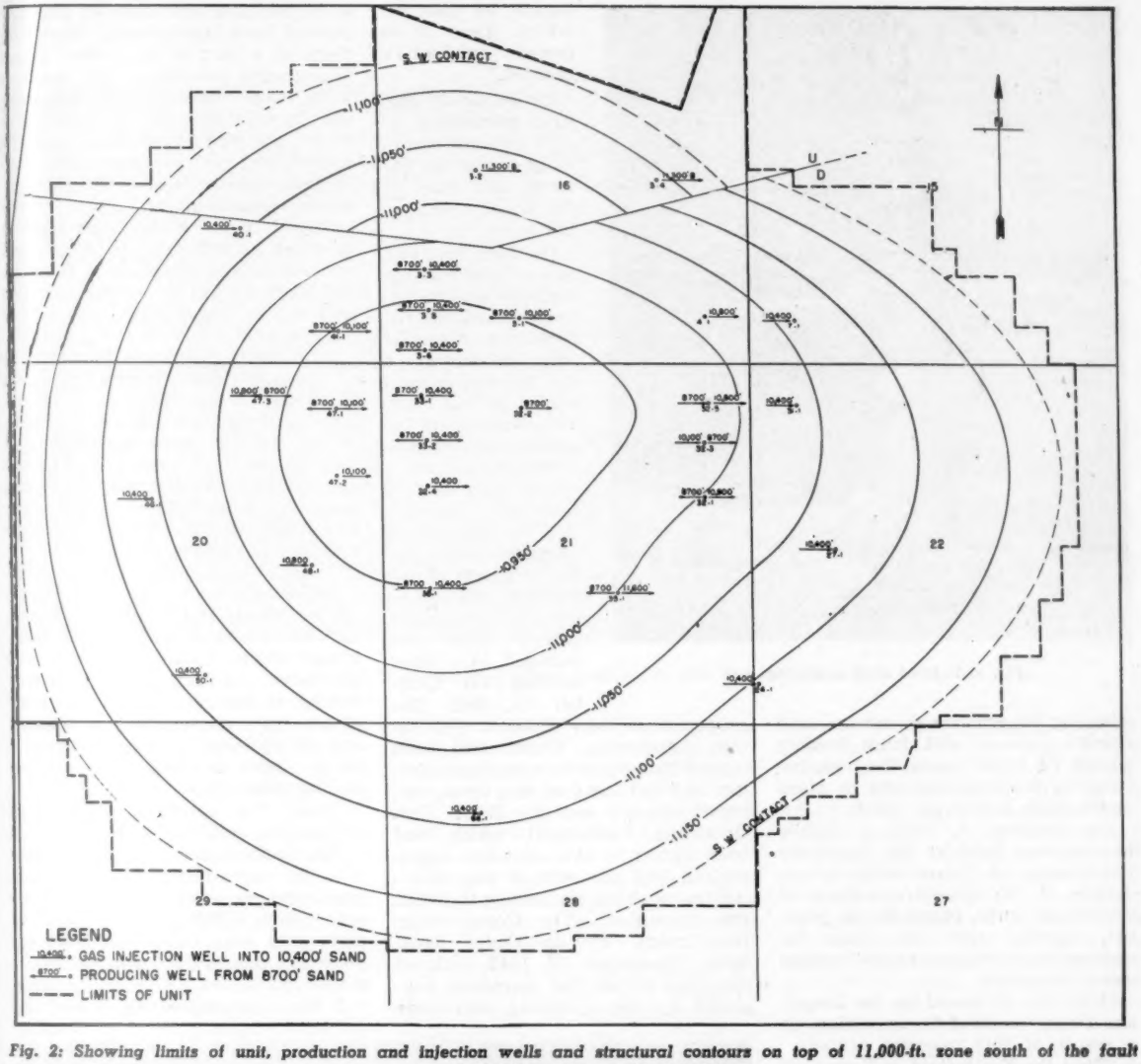


Fig. 2: Showing limits of unit, production and injection wells and structural contours on top of 11,000-ft. zone south of the fault and 11,300-ft. zone north of fault

Vermilion Parish School Board completed in the 11,300-ft. "A" sand in April 1940. Following the completion of the discovery well, the field was limited on the north and east by dry holes. Nine gas-distillate producing wells were drilled in the field by October 1941.

With the completion of nine of the above-mentioned producers, information obtained from core data, special tests and completed wells indicated that the producing formations below 8,000 ft. carried only gas and condensate with no commercial accumulation of oil. This fact led the operators in the field in October 1941, to a decision to unitize all producing horizons below 8,000 ft. to conserve this valuable natural resource, permitting orderly development and efficient exploitation of the field, and to construct a plant to recover "distillate" and other products, and to cycle gas in the condensate reservoirs.

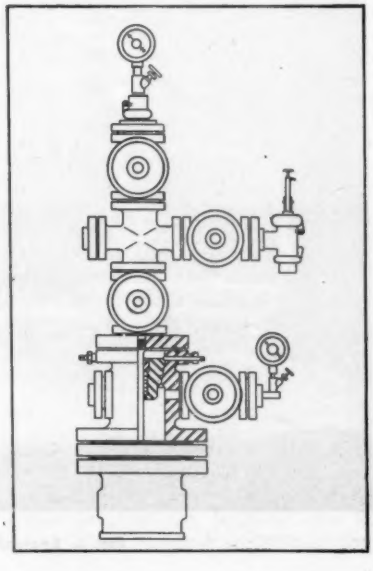


Fig. 3: (Right) Standard christmas tree as used by Erath unit

In February of the following year two additional wells were drilled which served to define more closely the limits of the field.

Administration of the proposed unit and cycling plant was placed under the authority of an operating committee. Under this committee, the field engineering, plant engineering, legal, geological, and auditing committees were organized to carry out the various phases of construction, development and operation. These committees were composed of representatives of the companies and individuals owning leases in the field.

Unitization

A unitization plan was proposed

Fig. 4: Typical dual producing well

whereby all equities of mineral and royalty owners and lease holders would be based upon the relative value of the hydrocarbons in place under each individual tract.

On January 5, 1942, a public hearing was held by the Louisiana Department of Conservation where details of the structure, nature of producing sands, character of product, together with the plans for unitization, development and cycling were presented.

Order No. 34 issued by the Louisiana Department of Conservation, as a result of this meeting, stated:

"That the Erath field in Vermilion Parish, Louisiana, embraces a number of separate proved sources of supply of natural gas and condensate and/or distillate, and that said Erath field is in fact a gas-distillate and/or condensate field.

"That recycling of gas in the Erath field, Vermilion Parish, Louisiana, is feasible, desirable and necessary, and that according to the known best operating methods for gas, distillate and/or condensate fields, said Erath field can be most efficiently operated for the maximum recovery of distillate and/or condensate and other light hydrocarbons, and with a minimum of waste as defined by law, and with the minimum number of wells, all in accordance with the best conservation practices, by the operation and development of said Erath field as a recycling project, thereby maintaining reservoir pressure with the resultant maximum recovery of distillate and/or condensate and other light hydrocarbons and the conservation of gas for which there is no present available market."

Order No. 34 also gave permission to drill two additional wells — one on the north and one on the south flank of the field.

On June 16, 1942, at a second hearing, tentative equity figures, based on information obtained from the drilling of the 11 wells completed at that date, were submitted together with details of the method upon which they were calculated. An initial development program calling for the drilling of 18 wells in addition to the 11 originally drilled wells was outlined, at a third hearing on October 15, 1942. The proposed Royalty Owners Unitization Agreement, which had been signed by royalty owners representing 72.2 per cent of the total one-eighth royalty and the Erath Unit Operating Agreement which had been signed by the operators representing 99.1 per cent of the seven-eighths working interests in the field, was presented. The Conservation Department, by its Order 34-A, dated November 19, 1942, ordered the area within the boundary suggested by the operating committee to be unitized and adopted and approved both agreements, including them as a part of the order. These agreements provided that equities were to be redetermined following the completion of 10 additional wells, but not later than January 1, 1944, and such redetermination to be then resubmitted to the Conservation Commission. Permits were obtained from state and federal agencies to drill the 18 additional wells which, in addition to reworking 10 of the wells drilled prior to unitization, constituted the initial development program for the unit.

At a fourth Louisiana Department of Conservation hearing held in Abbeville on December 17, 1943, the final equity determination was presented together with the data used in the equity calculations. The equity determination was approved by the Conservation Commission and superseded the tentative equity calculations which had been in effect up to that time.

An official unit map was drawn up on which the boundary of the unit was outlined. Each of the individual tracts within the unit was numbered and each of the wells was numbered according to the number of the tract on which it is located and an additional number designating the order in which it was drilled on the tract. (See map, Fig. 1.)

Under the approved articles of unitization, equities were allocated to the individual tracts as follows:

1. The acre-feet of productive sandstone in each separate reservoir below 8,000 ft. lying beneath each tract were calculated from revised net productive sand thickness maps.

2. The corresponding reservoir

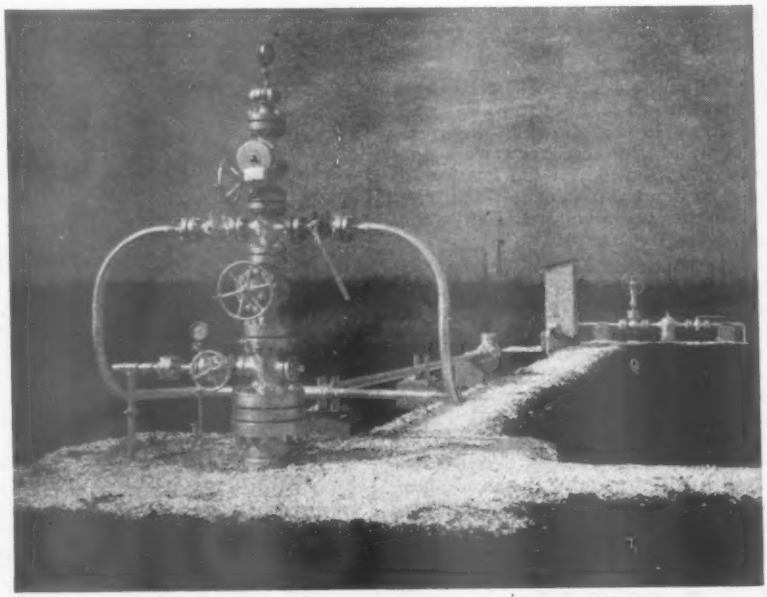


Fig. 5: Typical injection well

Fig. 6: Field lines, showing offsets installed to take care of expansion

volume containing hydrocarbons was calculated by applying factors for porosity and interstitial water determined from core analyses and electric-log data.

3. The hydrocarbon content of the hydrocarbon saturated space beneath each tract in each separate reservoir was then computed from extensive well test and reservoir sample data.

4. The aggregate dollar value determined for the initial content of all reservoirs beneath each tract expressed as a percentage of the aggregate dollar value of the contents of all reservoirs under the entire field below 8,000 ft. was the basis for the unit equity allocated to a tract.

Organization

The Texas Co., as owner of the largest interest in the Erath field, was appointed operator, and as such is responsible to the operating committee. The subcommittees acting in an advisory capacity make recommendations directly to the operating committee.

For obvious simplification in accounting, the unit is set up as a separate operating district and is under the supervision of a district superintendent. He coordinates the activities of the various branches of operation which are under the supervision, respectively, of the plant foreman, field foreman, petroleum engineer, district clerk and district warehouseman.

The plant foreman is in charge of the operation and maintenance of the plant and also supervises the work of the laboratory through the chief chemist. The head meterman is also under the jurisdiction of the plant foreman, although he handles all the meters, regulators and controls both in the field and in the plant.

All well workovers and new drilling are handled by the field foreman, as well as the field operation and maintenance.

A full-time staff of petroleum engineers is occupied with obtaining data on, and making studies of the reservoirs now being produced in order to establish production and injection rates to obtain optimum recovery. They also make recommendations and establish programs for workovers and additional drilling. Complete studies are being made in order to round out a program for the production of other sands not now being cycled so that the facilities will be kept at full capacity throughout its life.

The accounting, under the district clerk, is set up to handle all matters of accounting relating to the unit, including calculations of royalty payments, making up payrolls, etc.

Drilling and Completion Methods

As mentioned in an earlier part of this article there were 11 wells drilled prior to unitization. After the unitization was achieved, 18 additional wells were drilled and 10 of the original 11 wells were worked over to inaugurate the initial development program for the unit. This resulted in 14 dual completions, 31 producers and 12 injection wells. (See map, Fig. 2.) The initial development program merely covered the producing of 6 of the 19 sands in the unit and was considered all that would be necessary to supply the 200,000,000 cu. ft. of gas per day that was contemplated. Due to the scarcity of critical war material, shortage of labor, etc., it was imperative that initial operations would produce a maximum of products necessary for aviation fuel while utilizing a minimum amount of critical materials.

Casing design. — Seven-inch outside diameter casing was used in all of the 18 new wells drilled except one. Casing safety factors were agreed upon by members of the field engineering committee and were based on certain minimum standards, such as 1.5 internal pressure, 1.25 in collapse and 1.44 in tension based on minimum values, and these figures were used in arriving at a program for each well with the casing that could be obtained at the time.

As a rule casing was run in to the deepest sand in each well that would be produced during the life of the unit regardless of which sand was initially completed. This was true in each well except those that definitely did not fit into a secondary development program.

Only two strings of casing were used on all wells with 10¾-in. surface casing being set at approximately 2,200 ft. and the 7-in. set at total depth.

Tubing string.—To minimize fric-

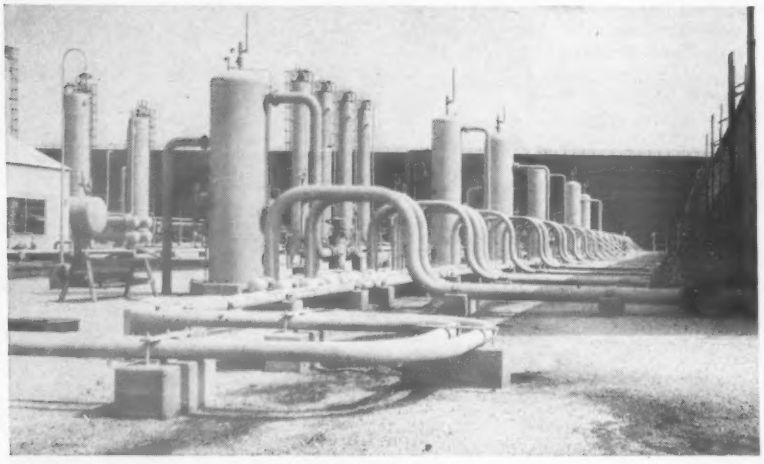


Fig. 7: Compressor discharge and suction piping and suction scrubbers

tional losses in both injection and producing wells and reduce effect of corrosion and erosion in producing wells, it was agreed that producing wells with volumes between 10 and 20 M.M.c.f. per day would use 3½-in. o.d. EUE tubing while wells with rates under 10 M.M.c.f. per day would use 2⅞-in. o.d. EUE tubing, and injection wells whose rate would be over 20 M.M.c.f. per day would use 4-in. o.d. A.P.I. EUE tubing.

Christmas trees.—The christmas trees on the 18 new wells and the 11 original wells are all of the same design although supplied by three different manufacturers. The christmas trees on some of the original wells had to be replaced to make this possible, but from a standpoint of standardization, it was deemed advisable to have all trees of the same design.

The standard christmas tree is the stuffing-box polished joint type in which the stuffing box is landed in the top of the tubing head and locked in place by lock screws in the upper flange of the tubing head. The polished joint and stuffing box are run through the blowout preventer with the well setting, and the stuffing box is locked in place. This seals off the annular space between the tubing and casing. To seal off the tubing a specially designed valve that will run through 6-in. blowout preventers is run on top of the polished joint. With this valve closed, the well is then under complete control and the blowout preventers can be removed from the tubing head. After the blowout preventers are removed, the christmas tree is screwed directly on to the top of the polished joint. The flange in the bottom of the adapter between the master valve and the top of the tubing head is threaded for the polished joint. The christmas tree is shown in Fig. 3.

In general, gate valves are used on all casing outlets for single and dual completions and also for the master valve on the christmas tree, while plug valves are used on the cutlet of the tubing wing and for the crown valve on the tree. Photographs of typical injection and producing wells are shown in Figs. 4 and 5.

Dual completion. — Two types of packers have been used in dual completions in the Erath unit. One is the retainer type and the other is a hook wall packer. Inasmuch as there is a differential load upward across the packer in dually completed wells, all packers in these wells are equipped with holddown, as well as holdup slips.

The packers are usually set above the lower zone and in completing the well, the flange between the top of the tubing head and the lower flange on the spool beneath the master valve are spaced so that they can be flanged when the packer is set with the correct amount of weight. The wells are washed through the tubing, displacing all mud from tubing and annulus until the pressure in the annulus has built up to approximately 1,500 p.s.i. When this pressure is reached, it has been found by experience that the upper zone will continue to clean itself; the packer is then set and the upper part of the christmas tree is bolted to the tubing head.

A right-hand safety joint is placed approximately two joints above the packer and a left-hand safety joint is run in the tubing string above the casing perforations in the upper zone. To minimize the possibility of sand from the upper zone falling on top of the packer and fouling it, a swab cup rubber is placed in the tubing string below the upper perforations. To minimize erosion of the tubing opposite the perforations of the upper zone, tubing centralizers are used above, through and below this zone.

Squeeze jobs. — All wells, either producing or injection wells, are squeeze-cemented above and below their perforated interval. In producing wells flowing at rates as high as 23 M.M.c.f. per day fairly high differential pressures exist. As pointed out before, all wells have casing set through the producing or injection zone. In the absence of definite assurance that the cement around the 7-in. casing would

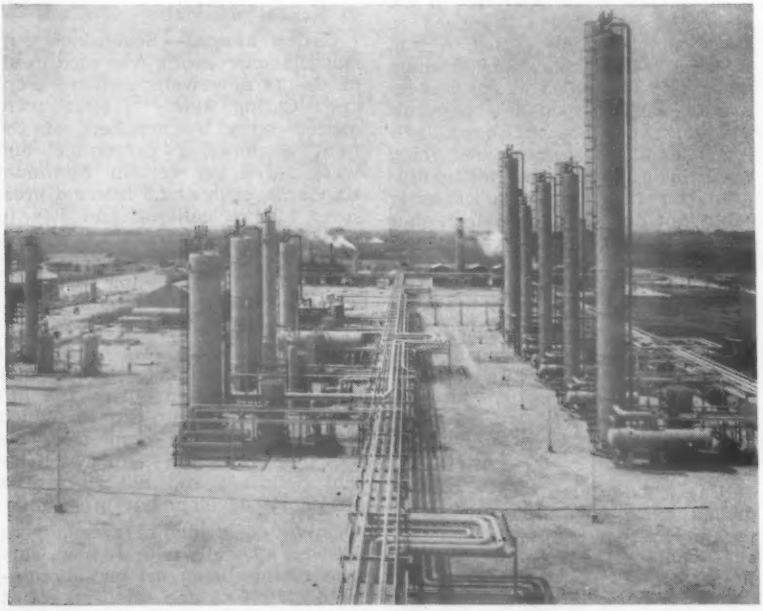


Fig. 8: Still group, with fractionating group shown at left

prevent the migration of water from below the salt-water level into the producing perforations by channeling in the annulus between the casing and the well bore, cement squeeze jobs have been placed below the perforated interval to prevent the intrusion. To prevent migration of water from an upper sand down to the producing sand, a top squeeze job is also placed immediately above the producing interval.

All injection wells are squeeze cemented above and below the perforated interval to confine the injected gas to the perforated interval.

All squeeze jobs are accomplished through an interval of 2-ft. which is perforated with 10 shots and maximum squeeze pressures of 5,000 p.s.i. are arbitrarily used for all zones from 8,700 ft. through the deepest or the 11,600-ft. zone.

Production

Operating practices.—All production is measured at the well through an orifice meter, following the standard procedure for high-pressure gas measurement as established by the Natural Gasoline Association of America. This method of measuring the quantity of composite gas was first checked in the field by means of calibrating tests. Several wells were produced through a separator and into a stock tank. Liquid production was gaged in the stock tank and gas was measured at the separator and from the stock tank. The composite meter coefficients were then established to indicate the correct amount of gas and liquid produced.

Periodic checks on the meters and on actual well production will be made with a full-scale portable separator and meters operating under normal flowing conditions. This will be a portable testing apparatus for production tests on any well, or for further checks on meter accuracy.

The field gathering system consists of a high-pressure system operating at approximately 2,400 p.s.i., and a low-pressure system operating at about 1,000 p.s.i. The high-pressure system gathers production from all wells except those producing from the 8,700-ft. sand. The low-pressure system carries the composite production from the 8,700-ft. sand.

Rate of production.—Shortly after initial operations, about 220,000 M.c.f. per day of composite gas was being produced into the plant and the total plant product from this quantity of gas was approximately 16,000 bbl. All residue gas after plant fuel and shrinkage amounting to about 197,000 M.c.f. is injected back into the formations.

Present Cycling Program

The present cycling program includes four sands being cycled and two being produced for makeup gas with the highly prolific 10,400-ft. sand as the nucleus and main producer.

The 8,700-ft. sand is being produced from 14 wells, 13 of which produce from the casing in dual completions; there is only one injection well in this sand. The cycle pattern in this sand is from this injection well on the east side of the field to the 14 producing wells generally located in the western half of the productive area.

The 10,100-ft. sand produces from four wells on the west side of the field; injection is into only one well on the east side about 3,000 ft. from the closest producing well.

The 10,400-ft. sand is cycled by means of eight injection wells on the pheriphery of the field, and by seven producing wells in a north-south line on the approximately structural high of the field. This sand contributes over two-thirds of the present gas and liquid production.

The 10,800-ft. sand is cycled from west to east. Injection is into two wells on the west side, and production is from three wells on the east side.

The 11,300-ft. "B" north sand produces from two wells in the northern part of the field, north of the major fault. There is no injection of residue gas back to this formation.

The 11,600-ft. sand is the other sand from which gas is taken for makeup gas. There is only one well producing from this sand.

Future Cycling Program

Future cycling programs will likewise be built around one large sand as a nucleus, such as the 11,100-ft. sand. The same wells for injection and production, as are now used for the 10,400-ft. sand, are planned to be employed in cycling the 11,100-ft. sand. Smaller, shorter-life sands will be integrated with the 11,100-ft. sand. It is planned that the small reservoirs and the sands below the 11,100-ft. sand will produce makeup gas at relatively low rates with the expectation that water encroachment will maintain pressures, thus preventing condensation of liquids in the reservoirs. If there is not sufficient water encroachment to accomplish this in the deeper sands, they will be cycled when the pressure is lowered sufficiently for them to be handled with present plant equipment.

Reservoir Engineering

Producing sands.—There are 19 sands in the Erath unit from 8,100 to 11,970 ft. in depth which have been tested or which are indicative of production by core evidence

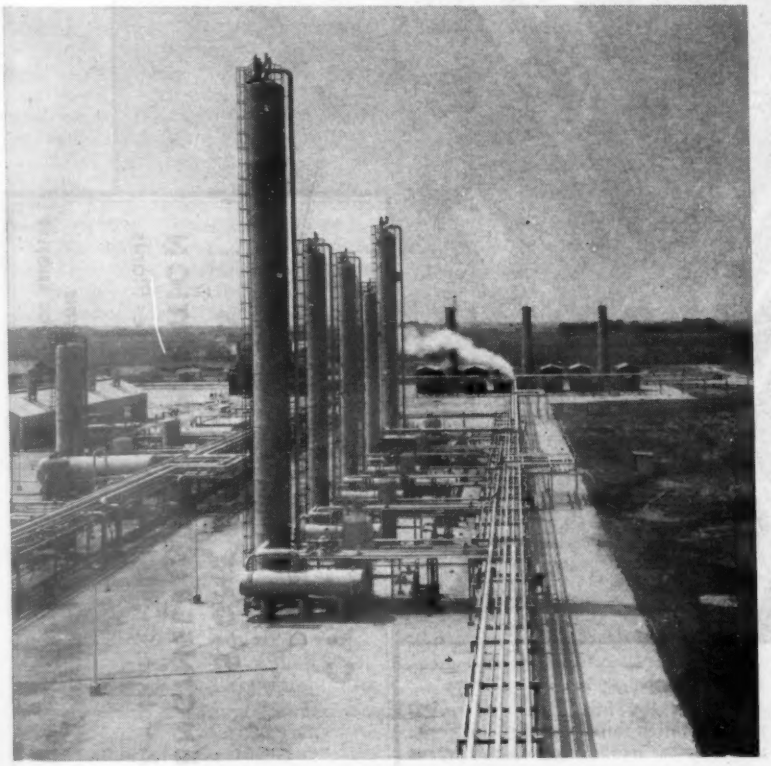
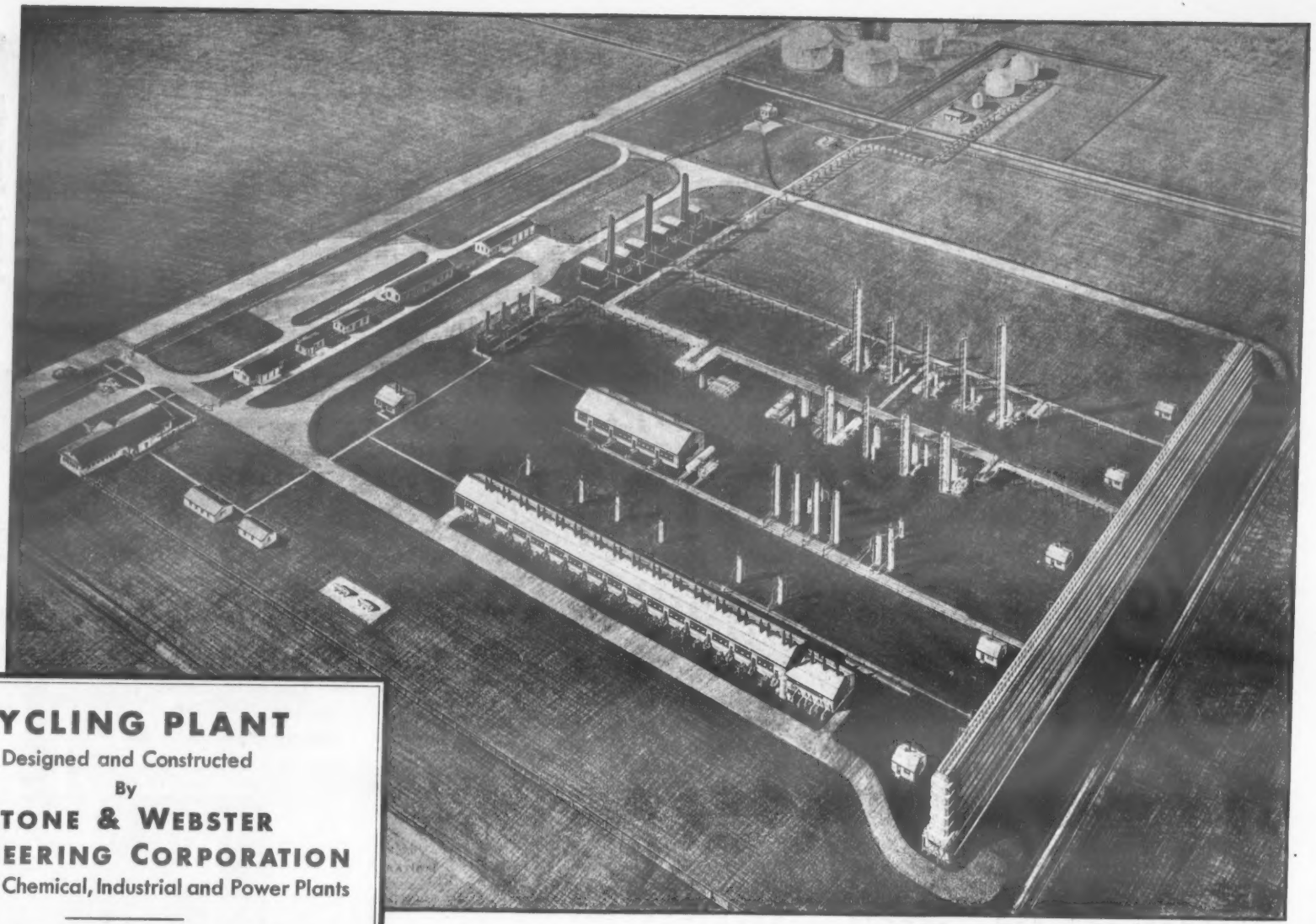


Fig. 9: View of fractionator group



CYCLING PLANT

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By

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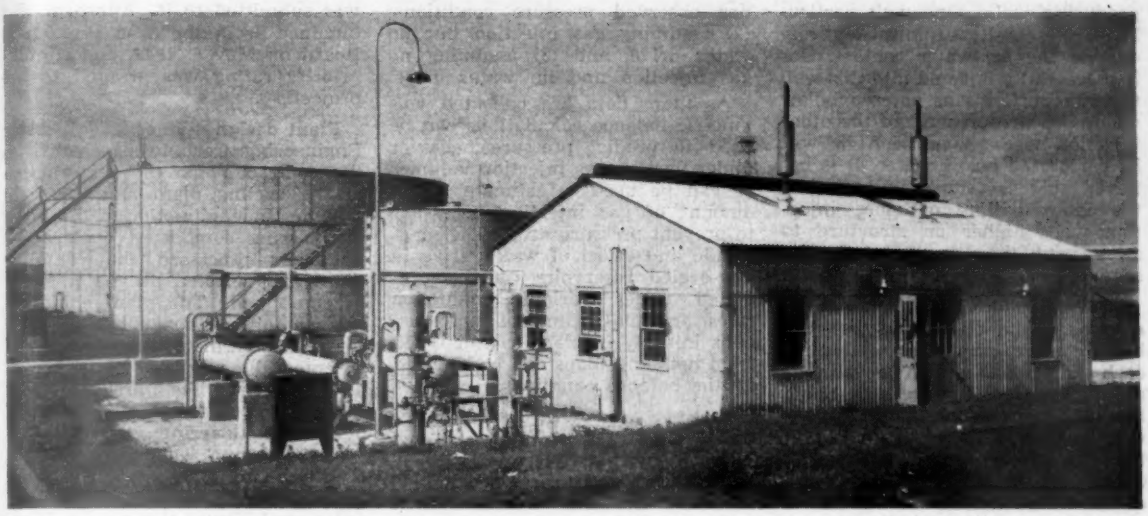

Fig. 10: Vapor recovery unit, with 1,000 bbl. absorption-oil tank, and two 10,000-bbl. No. 2 product storage tanks

and electric logs. These sands are designated by the depth, to the nearest 100 ft., of their water level. A major fault on the north side of the field divides three of the sands thus creating a total of 22 gas-condensate reservoirs.

Production tests were made of 10 sands in Well 47-1 and 20 additional tests were made from individual sands in various other wells. From these 30 tests and from hydrocarbon analyses and pressure-volume-temperature data taken from gas and liquid samples from the sands tested, complete reservoir data were collected. Duplicate samples were taken from each major sand, and the samples were run in two separate laboratories so that the final accepted results were an average of at least two tests. Most of the hydrocarbon analyses were made by The Texas Co. and Phillips Petroleum Co. The P.V.T. work was done by California Institute of Technology; Phillips Petroleum Co.; Core Laboratories, Inc., and Houston Laboratories.

Reservoir pressures vary from 3,935 p.s.i.a. to 6,245 p.s.i.a. and reservoir temperatures from 180° to 219° F. Reservoir temperatures and pressures are normal in all reservoirs, except the pressure in the 11,900-ft. sand is considerably above normal. The average sand thickness of the 19 sands varies from 4.5 to 67.5 ft. and the maximum sand thickness varies from 8 to 178 ft. Conventional or wire-line cores were taken in the major sands in most of the unit drilled wells. Porosity and permeability are both high; average porosity varies from 24 to 29.8 per cent and average permeability from 500 to 5,000 md. with some values of over 10,000 md. being found. Over 11,400 ft. of cores were taken and electrical log surveys were run in every well. Average interstitial water values taken from electric logs vary from 13 to 35 per cent.

Reservoir volume factors, defined as the volume of reservoir space required to contain one unit volume of specified material and usually referred to as barrels of pore space originally containing 1 bbl. of plant product were obtained from the reservoir fluid in each of the major sands. Reservoir volume factors were computed for each reservoir, using the hydrocarbon analyses and compressibility data either experimentally determined by California Institute of Technology, Core Laboratories, or Phillips Petroleum Co., or calculated compressibility data from the chart by Standing, Katz et al. Reservoir volume factors, as defined above, were used to convert hydrocarbon saturated pore space into equivalent barrels of plant product (defined as 80 per cent of the butanes, 100 per cent of the pentanes plus) and thousand cubic feet of residue gas (defined as all methane, ethane, propane, and 20 per cent of the butanes) contained therein under existing reservoir conditions. These reservoir volume factors were used directly in computing the equity value-in-dollars per acre-foot used to determine the equities under each tract in the unit.

Methods of computing hydrocarbons initially in place. — The net sand volume of the sand in each pool within the productive limits of each pool was determined from the net sand thickness maps prepared by the geological committee in October and November 1943. Using this net sand volume, average porosities, interstitial water saturations, hydrocarbon contents and reservoir volume factors for plant product and residue gas, the quantity of hydrocarbons in place in each pool was computed. The equation by which these factors can be reduced to quantities of hydrocarbon initially in place is as follows:

Barrels of plant product = acre-feet of sand × 7,758 × porosity × (1-interstitial water)/reservoir volume factor.

Model studies. — Potentiometric model studies were run on five of the major sands in the fall of 1942 before any of the unit wells had been drilled. These studies were run on models constructed from net sand maps furnished by the geological committee. Most of the unit drilled wells were located on the basis of the cycling patterns developed from these model studies. At the time these studies were made the water level in the sand was considered the limit of gas movement, and below water injection was not contemplated. Additional data collected from the drilling of the 18 wells changed the former conception of the location of the major fault; indicated that the southwest flank of the 8,700-ft. sand was quite shaly; showed that a thick shale break exists in the 10,400-ft. sand on the west flank—all of which changed the picture. Model studies are being rerun on all of the sands to be cycled taking into consideration all of the above factors and using reservoir space maps as a basis for the models instead of net sand maps. The wells having been drilled and, therefore, the cycling pattern being fixed, any variations indicated by the model studies will be taken care of by adjusting the producing and injection rates of the wells. All of the wells drilled for injection into the 10,400-ft. sand (on the flanks) have less sand above water than the

producing wells. One well particularly, No. 40-1, is almost entirely outside the gas-water contact. Gas is successfully injected into this well through perforations entered below water. As a result most of the other injection wells have been or will be perforated below water. It is believed this procedure will obviate the later drilling of more injection wells higher on structure to sweep out the lower part of the sand.

Reservoir volume maps and cross-sections.—Detailed cross sections are being constructed and correlated for each major sand using electric logs as the basis for the sections. Shale breaks are correlated and studied with special emphasis on the effect they may have on the path of the cycled gas. From cross sections and using the porosity and interstitial-water data mentioned before, reservoir volume maps are being constructed. The contours on these maps represent hydrocarbon saturated pore space in units of barrels per acre. Such maps will be used as the basis for models for future potentiometric model studies. These volume maps will also be used to plot estimated dry-gas invasion patterns or dry-gas wave fronts at regular intervals.

Volumetric balances and production vs. pressure history.—Volumetric balance calculations are being made every 3 months on each reservoir being produced. These calculations are merely a balance of the reservoir volume voided (composite gas production plus water production) against the reservoir volume filled (expansion of reservoir fluid plus gas injection plus water influx into the reservoir). These calculations are made: (1) Under observed pressure conditions; (2) assuming gas injection but no water drive, and (3) assuming no gas injection and no water drive.

As more data are collected volumetric balance calculations can be used to predict pressure behavior under various gas injection volumes or can be used to estimate actual amount of gas injection necessary to prevent pressure drop. The magnitude and effect of water drive in non-cycled reservoirs can be predicted under various production rates, and the volume of hydrocarbons initially in place as calculated from net sand maps can be checked by the balance equations.

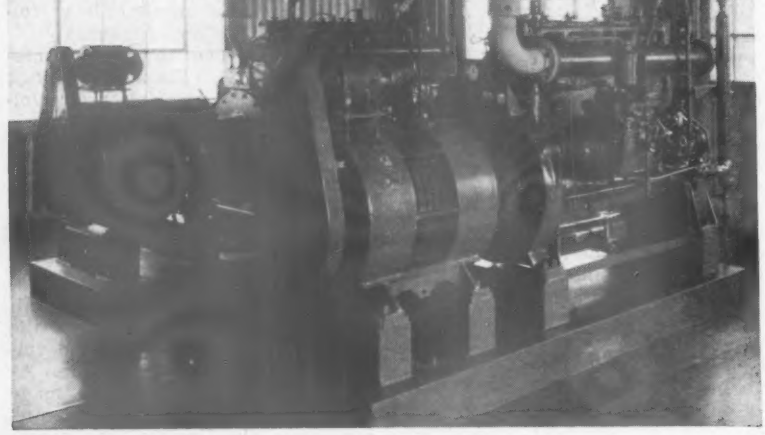

Fig. 11: Inside view of generator house

Cycling Plant

Plant engineering committee.—Following extensive field tests to determine reservoir-composition and well-capacity data, the plant engineering committee made a detailed study of these data and determined that a plant of approximately 200,000 M.c.f. per day capacity was the proper size, and it was decided to install a high-pressure absorption plant, operating at a maximum pressure of 2,000 p.s.i.

In conjunction with this study, an initial estimate of plant equipment and cost was prepared, which was submitted to and approved by the operating committee.

The Petroleum Administrator for War was interested in the Erath project from its initial conception because of the substantial quantities of butanes and isopentane that would be made available for the 100-octane program. This department was kept advised of the progress of all phases of the work being done on the Erath unit and the initial estimate of equipment and cost was submitted to it. Approval was obtained from the War Production Board on May 8, 1942, and a high-priority rating was granted to the project.

Plant design.—Stone and Webster Engineering Corp. was selected as the contractor for the construction of the cycling plant and the field system. Under direction of the plant engineering committee, contractor's engineers processed the complete plant and selected all major items of equipment. The plant engineering committee then submitted this to the operating committee which accepted the proposed plant design and authorized the purchase of all items of equipment and the final detailed engineering work.

Plant design embodies all the latest cycling plant practices, and the A.S.A., A.S.M.E., and A.P.I. codes are followed throughout. Wartime restrictions required that the plant be built with a minimum of critical materials and this requirement was complied with as closely as possible.

Plant construction.—Actual construction of the Erath plant started in November 1942. Construction proceeded as rapidly as possible with slow material deliveries handicapping the work appreciably. In many cases it was necessary to scour the country for acceptable substitutes in order to allow the work to proceed without undue delay, and in addition, special assistance from PAW and WPB was necessary in some cases to insure deliveries of vital equipment and material.

Due to the extremely high injection pressure contemplated (4,700 p.s.i.), it was necessary to use 70,000 p.s.i. minimum tensile pipe in the fabrication of the injection-gas discharge headers within the plant area. Special care was necessary in welding and stress relieving this high-tensile pipe.

Some interesting construction facts are listed below:

1. Total yards of concrete poured —11,658.
2. Total feet of pipe installed in plant—145,641.
3. Total feet of pipe installed in field lines—80,307.
4. Total number of vessels installed—60.
5. Total number of buildings erected—26.
6. Total horsepower installed in prime movers—18,600.
7. Maximum number of men employed—841.

The plant was put into operation in April 1944 and was quickly brought up to design capacity with few difficulties being experienced.

Field System

Because the Erath field is located in one of the most fertile sugar cane and rice growing areas in southern

Louisiana, the field lines were all buried approximately 24 in. below grade. As the lines were buried, it was possible to reduce pressure drop and cost by installing offsets instead of loops to take care of expansion. A picture illustrating the type installation used is shown (Fig. 6).

Field gathering system.—The field gathering system is divided into two completely separate systems. The high-pressure system operating at approximately 2,400 p.s.i. gathers the production from all zones below the 8,700-ft. sand. This system consists of lines from 3-in. schedule 160 to 10-in. 160 schedule Grade B pipe and is designed for a maximum operating pressure of 4,000 p.s.i. permitting the wells to be closed in from the plant if necessary. The low-pressure gathering system operates at approximately 1,000 p.s.i., gathering all production from the 8,700-ft. sand. This system consists mainly of 2-in. schedule 80 Grade B pipe, but ranges up to a maximum size of 6-in. schedule 120 Grade B, and is designed for a maximum operating pressure of approximately 2,800 p.s.i., permitting this system also to be shut in against the producing wells if necessary.

A rather unique feature of the high-pressure gathering system is the use of six of the 10,400-ft. wells, normally producing approximately 120 million feet per day as a separate floating system to reduce automatically production in case any of the compressors go down. This system operates at pressures varying from 2,400 to 3,000 p.s.i. and the gas passes through a 4-in. series 250 reducing regulator which maintains 2,400 p.s.i. on the main high-pressure field gathering system. The 2,400-p.s.i. system flows into the plant through reducing regulators, maintaining compressor suction pressure at 1,850 p.s.i. Consequently, any reduction or increase in the capacity of the compressors is immediately reflected in a reduction or increase in the volume of gas produced from the six floating 10,400-ft. wells.

Production from all producing wells is metered at each well through a typical meter run comprised of a junior orifice fitting and a 4,000-lb. orifice meter. The meter runs are installed horizontally with the orifice taps pointed up and have a shelter built over the meter and line to retain sufficient heat from the line to prevent hydrate formation in the meter leads during winter operations. Seal pots are used on all producing meter runs. Piston-type check valves are installed on all high-pressure meter runs as well as plug valves for positive shut off, the check valves being used to eliminate any danger of backflow into the relatively lower pressure sands from the field gathering system in case it should be completely shut in from the plant. A removable bend with unibolt unions on each end is installed in the meter run so that the portable full-scale separator can be connected into the line for calibration of the meter under flowing conditions and determination of gas-liquid ratios.

Injection system.—The gas-injection system has four 6-in. XX Grade B main pipe headers serving the field. Side laterals consisting of 4-in. and 3-in. XX Grade A and Schedule 160 Grade B pipe deliver the gas to the individual wells. This system is designed for a maximum working pressure of 5,000 p.s.i. under the A.S.A. Code for pressure piping outside of refinery limits. At present, the discharge pressure normally operates at 4,600 lb., but higher pressures are anticipated at some later date when injection is started in the deeper sands.

A liquid injection system is provided to four wells for the injection of propane and the possible injection of natural gasoline. This system consists of 2-in. to 4-in. schedule 80 Grade B pipe and was designed for a maximum operating pressure of approximately 2,800 p.s.i. The gasoline-injection system was provided as a war-emergency measure in case it was found necessary to store gasoline underground for a short period of time.

The injection wells are provided with Series 250 junior orifice fittings with 5,000-lb. orifice meters and are housed similarly to the production meters to prevent hydrate formation in winter. Each gas-injection well is provided with a separator pot for scrubbing out any lubricating oil carried into the system from the compressors. Piston-type check valves are provided on all injection-meter runs to prevent backflow of gas from the well in case of injection-line failure.

Plant gas system.—The high-pressure gas enters the plant from the east and west through the high-pressure gathering system as previously

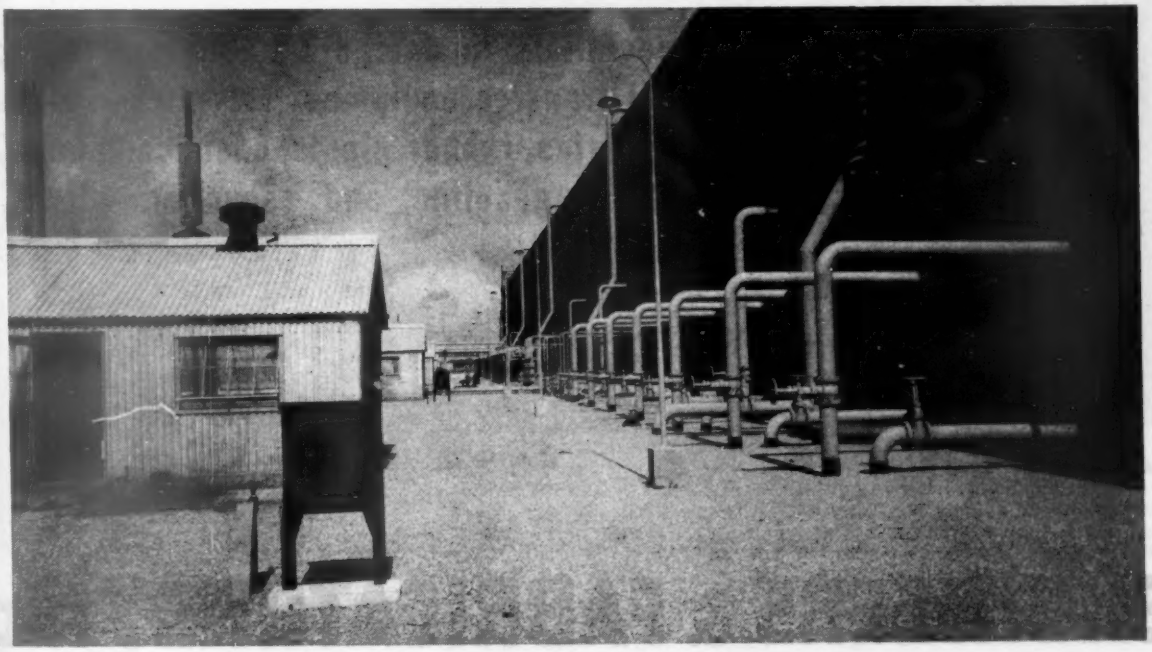

Fig. 12: **Cooling tower and pump houses**

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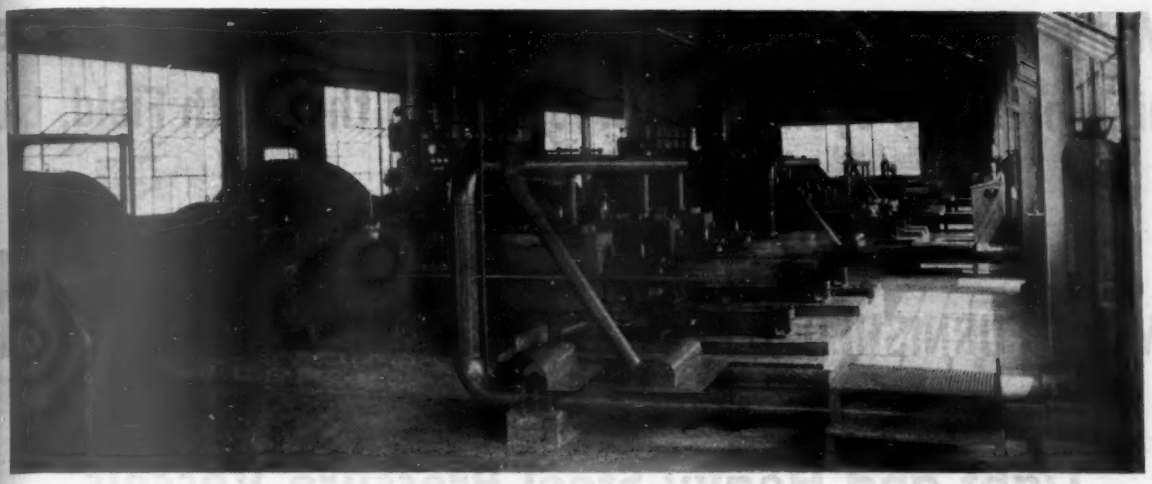

Fig. 13: Interior view of lean-oil pump house

described. The gas flows through a 10-in. Schedule 160 Grade B header into four 4,000-lb. maximum-working-pressure atmospheric sections, located in the cooling tower, where the gas is cooled from 130° to 100°. The gas then passes through two 4-in. Series 250 reducing regulators which operate to maintain 1,850 p.s.i. on the compressor suction. This expansion from 2,400 to 1,850 p.s.i cools the gas to approximately 90°. The gas then passes into the two 5-ft. by 18-ft. 2,000-p.s.i. maximum-working-pressure inlet separators. These separators have a wall thickness of $4\frac{5}{16}$ in. and are of multilayer construction. Scrubbing elements are installed in these separators to eliminate condensate carryover. Retrograde condensate is separated in these vessels and the gas passes from them into the four 54-in. by 50-ft. high-pressure absorbers. These vessels have 20 bubble trays and a total shell thickness of $3\frac{1}{8}$ in., comprised of an inner layer of $\frac{7}{16}$-in. plate and 14 outer layers of ¼-in. plate with a maximum working pressure of 2,000 p.s.i.

Compressor plant.—The gas passes from the absorber through the suction scrubbers which are similar to the inlet separators in design and into the compressor suction header. These scrubbers have scrubbing elements installed in them to extract any absorption-oil carryover before the gas reaches the compressor cylinders. The gas flows from the 12-in. suction header into the fifty-one $3\frac{1}{4}$-in. compressor cylinders on the sixteen 800-hp. engines. The gas is compressed to the present discharge pressure of 4,600 lb. in one stage and passes out through the four 6-in. XX Grade C discharge headers. Two of these headers leave the plant on the east and two serve the west side of the field. The four headers are split in two separate systems so that it is possible to carry one side of the field at a somewhat lower discharge pressure, if desirable, to conserve horsepower. A 6-in. Series 250 piston-type check valve is provided on each of the discharge headers as they leave the plant area to prevent the backflow of gas from the injection field lines in case of a plant line break.

In addition to compressing the injection gas, the compressors handle four plant recompressor services.

1. Five $4\frac{1}{2}$-in. compressor cylinders requiring 1,000 h.p. recompress the flash gas from the 1,000-p.s.i. absorption oil and the 1,000 p.s.i. distillate flash drums to 1,850 p.s.i. This gas passes through atmospheric cooling sections and enters the high-pressure absorbers with the inlet gas.

2. Four $5\frac{1}{2}$-in. compressor cylinders requiring 800 h.p. recompress the flash gas from the 400-p.s.i. absorption oil and 400-p.s.i. distillate flash drums to 1,000 p.s.i. This gas passes through cooling sections and enters the 1,000-p.s.i. recompressor suction.

3. Two 16-in. compressor cylinders requiring 400 h.p. recompress the uncondensed vapors from the absorption oil and distillate still reflux accumulators. The gas is discharged through a condenser into the fractionator feed tank operating at 85 p.s.i. These cylinders take suction at approximately 10 p.s.i.

4. Two 28-in. cylinders requiring 400 h.p. recompress the vapors from the refrigeration flash drum taking suction at 15 in. of vacuum and discharging at 40 p.s.i.

A rather unusual feature of the compressor-plant installation is that each of the recompressor cylinders described above is on a separate Clark engine in combination with three of the injection cylinders. This gives the compressor plant considerable flexibility in that shutting down any one unit only partially reduces one recompressor service. An important point in compressor-plant design was providing sufficient capacity and flexibility to eliminate any necessity of flaring gas even under widely varying operations.

In addition to the suction scrubbers on the main injection service, each of the recompressors has a suction scrubber to protect the cylinders from any unusual liquid carryover that might occur under upset plant conditions. (Fig. 7.) All suction scrubbers are equipped with high-level alarms. These alarms are connected to a horn and light system which gives immediate warning to the operators when a liquid level appears in any of these vessels.

Compressor-plant auxiliaries.—The jacket water system for the sixteen 800-h.p. engines consists of three 5,300-g.p.m. centrifugal pumps, driven by multicylinder gas engines, which circulate condensed water through a closed cooling system. The temperature rise on the jacket water is held to about 8°. Two 1,900-g.p.m. centrifugal pumps, driven by multicylinder gas engines, circulate well water through the engine oil coolers. Starting air is provided by two multicylinder engine-driven compressors. No. 1 compressor has a capacity of 67 cu. ft. per minute, while No. 2 (the standby) delivers 30 cu. ft. per minute at 250 p.s.i. pressure.

Distillate system.—The retrograde condensate (distillate) separated in the inlet separators is flashed down to a 6-ft. by 17-ft. 6-in. flash drum operating at 1,000 p.s.i. The distillate from this vessel flows through a level control valve to a 5-ft. by 12-ft. flash drum operating at 400 p.s.i. The flash gas liberated in these two vessels pass to their respective recompressor systems.

The low-pressure production from the 8,700-ft. wells enters the plant through a 6-in. Schedule 120 Grade B line and flows into a $2\frac{1}{2}$-ft. by 12-ft. separator operating in parallel

Many of the steel pressure vessels incorporated in the high pressure cycling plant, located in the Erath Field, La.

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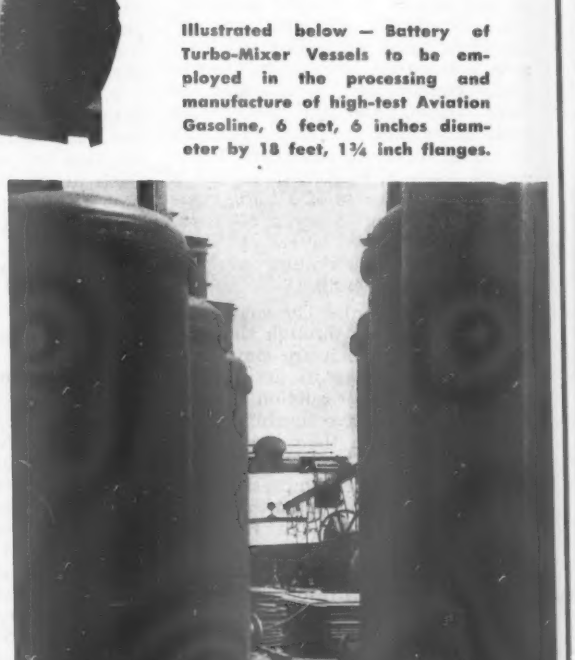

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with the first distillate flash drum. The gas and liquid leaving this separator are measured as a check on the individual well metered production from the 8,700-ft. sand. The liquid from this separator then joins the main distillate stream in the second distillate flash drum.

The combined liquid streams are then flashed to a 10-ft. by 40-ft. horizontal surge tank operating at 65 p.s.i. The gas passes directly into the low-pressure absorber.

Level-controlled drain regulators are provided on this vessel as well as the inlet separators and the first distillate flash drum for draining off produced water and basic sediment.

The raw distillate is then pumped through a set of overhead and bottom exchangers into the 5-ft. by 10-ft. hot distillate flash drum operating at 90 p.s.i. and 335°F. The hot vapors from this drum pass directly to the distillate still while the liquid flows to the two distillate furnaces. These furnaces were designed for a total heat load of 15,350,000 B.t.u.'s per hour and have an effective heating surface of 2,032 sq. ft. each. Each furnace is capable of carrying approximately three-fourths of the total load. The furnaces have a common 5-ft. 3-in. i.d. brick stack 75 ft. high.

The distillate is heated to 520°F. in the furnace and returns to a 9-ft. 20-tray distillate still operating at 60-p.s.i. pressure. A small amount of stripping steam is used in the still and a top temperature of 375°F. is maintained by a temperature controller operating on a control valve in the reflux pump discharge. A 41.5° A.P.I. bottoms product having a 400° i.b.p. is made on this still while the overhead product (400° e.p.) is partially condensed and the liquid pumped to the depentanizer feed tank. The vapors enter the low-pressure recompressor system.

Absorption-oil system.—The lean oil is pumped to the four high-pressure absorbers by four 4-in. by 18-in. horizontal triplex ram pumps driven by 400-h.p. gas engines. Three of these pumps are normally operated and circulate approximately 914 g.p.m. over the absorbers. A circulation rate of approximately 6.6 gal. per M.c.f. of residue gas is maintained on each absorber. Individual meters record the lean oil and residue gas volumes for each absorber.

The rich oil is flashed down from the absorbers through two 6-ft. by 12-ft. flash drums operating at 1,000 and 400 p.s.i., respectively. The gases leaving these flash drums enter the recompressor systems. The rich oil from the second rich-oil flash drum enters a third flash drum (8 ft. by 11 ft.) operating at 65 p.s.i. where low-pressure gas is liberated directly into the low-pressure absorber. Rich oil from the 5-ft. 6-in. 22-tray low-pressure absorber flows by gravity into the third rich-oil flash drum uniting with the main oil stream. The combined oil stream is pumped through the 12 lean-oil-to-rich-oil exchangers having total of 35,364 sq. ft. of surface. The rich oil leaves the exchangers at 390°F. and enters the 6-ft. by 10-ft. hot-oil flash drum where the flashed vapors pass to the high-pressure still. The oil then flows to the two rich-oil furnaces. These furnaces were designed for a total heat duty of 22,250,000 B.t.u.'s per hour and have 3,006 sq. ft. of effective surface each. Tube sizes are 4 in., 5 in. and 6 in. The natural-draft brick stack for the combined furnace gases is 6 ft. 3 in. i.d. and 75 ft. tall.

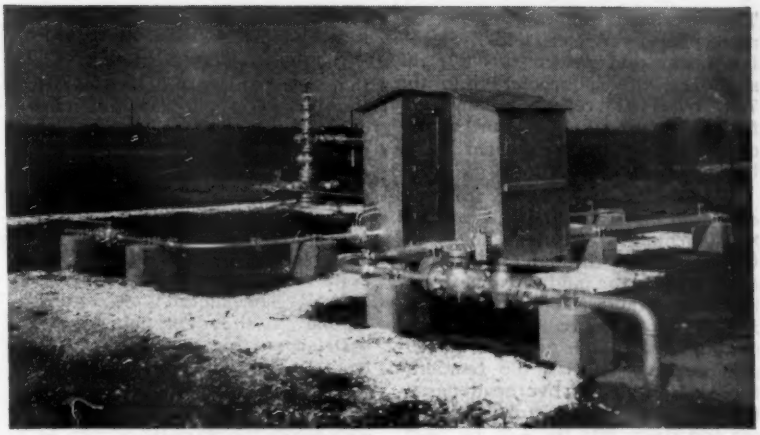


Fig. 14: View of Well 33-1, showing typical producing-well meter-run hookup

The hot rich oil leaves the furnace at 500°F. and returns to the 9-ft. 20-tray high-pressure still operating at 60 p.s.i. pressure. Stripping steam is added to the still and a 390°F. end-point product taken overhead. The top temperature is maintained at 265°F. by a temperature controller operating on the reflux. The overhead from the still passes through atmospheric condensers and well-water exchangers for subcooling and returns to the reflux accumulator partially condensed. The liquid product from this accumulator is pumped into the depentanizer feed tank while the vapor enters the recompressor system.

The hot oil from the bottom of the high-pressure still flows into the 9-ft. 22-tray low-pressure still operating at 15 p.s.i. where additional stripping steam is added to bring the initial boiling point of the absorption oil up to 470°F. The hot lean oil is then pumped back through the lean oil-rich oil exchangers, the atmospheric cooling sections and the well water-lean oil subcoolers into the 6-ft. by 25-ft. horizontal lean-oil storage tank.

The 41.2° A.P.I. absorption oil is maintained at an end point of approximately 625°F. by passing a small shunt stream through a 3-ft. by 19-ft. five-tray reclamation still where a large quantity of stripping steam distills the oil overhead. The reclaimer operates at 15 p.s.i.

Fig. 8 illustrates the layout of the still operating and showing the two oil stills in the foreground with the low-pressure absorber and distillate still behind them.

Fractionating system.—The plant fractionating system consists of five columns arranged in one operating aisle as shown in Fig. 9. The general plan of fractionation is as follows:

A preliminary separation of isopentane and lighter from the 400°e.p. raw gasoline is made in the depentanizer. The overhead from this column contains considerable normal pentane and some hexanes. This overhead stream passes into the four remaining fractionators where it is deethanized, depropanized, debutanized, and deisopentanized in turn. The pentanes plus bottoms from the last column join the bottoms from the depentanizer to make a deisopentanized 400-e.p. gasoline.

Depentanizer.—The 400-e.p. raw gasoline collected in the 8-ft. by 40-ft. horizontal depentanizer feed tanks is pumped through a bank of 4-ft. feed bottom exchangers into the 8-ft. 40-tray depentanizer. This fractionator operates at 145 p.s.i. pressure and a top temperature of approximately 175°F., having a reflux ratio of 1½ to 1 on the net overhead. The bottom temperature of 422°F. is maintained by the two depentanizer furnaces. These furnaces have a heat duty of approximately 12,000,000 B.t.u.'s and an effective heat surface of 1,778 sq. ft. each. Circulation through the furnaces is carried at approximately 1,050 g.p.m. by a turbine-driven 6-in. single-stage centrifugal pump taking suction from the fractionator and controlled by a rate of flow controller on the pump discharge. The bottoms from this column pass through the feed-bottoms exchanger direct to storage.

The overhead vapors flow to the atmospheric condensers in the cooling tower and return through the shell and tube subcoolers into the 7-ft. by 14-ft. reflux accumulator from which a small amount of uncondensed vapors is returned to the low pressure absorber.

Deethanizer.—The liquid from the depentanizer accumulator is pumped by a turbine-driven eight-stage centrifugal pump through a feed-bottoms exchanger and a steam preheater into the 5-ft. 30-tray deethanizer (500 p.s.i. max. working pressure). This column operates at 400-p.s.i. pressure with a top temperature of 130°F. The overhead passes through two shell-and-tube condensers and flows into the 4-ft. by 14-ft. reflux accumulator. All condensed liquid is returned as reflux to the column and the noncondensed gas passes into the 400-p.s.i. recompressor system.

Reboiling heat is supplied through a conventional external reboiler operating on the 250-p.s.i. steam system. The bottom temperature is approximately 265°F. The bottom flows from reboiler into 6-ft. by 40-ft. horizon depropanizer feed tank.

Depropanizer. — The depropanizer feed flows through a manually controlled valve from the insulated feed tank into the 5-ft. 6-in. 40-tray depropanizer where propane is taken overhead. This tower operates at 245 p.s.i. pressure with a top temperature of 124°F. A constant reflux rate is maintained which is approximately 5½ to 1 of net overhead.

High-pressure steam is controlled to the reboiler (493 sq. ft. heating surface) by a rate of flow controller. This controller is reset by a temperature controller operating from the temperature on the twenty-ninth tray from the bottom which adjusts for small variations in the feed rate and composition.

Debutanizer.—The bottoms from the depropanizer reboiler flow into the 5-ft. 6-in. 40-tray debutanizer operating at 100-p.s.i. pressure. A mixed butane cut is taken overhead on this tower. This column operates with a top pressure of 133°F. and a constant reflux rate of 163 g.p.m. giving a reflux ratio on the net overhead of 2½ to 1. The reboiler temperature is approximately 225° F. The method of control is similar to the depropanizer.

Deisopentanizer.—The bottoms from the debutanizer are pressured into the 8-ft. 60-tray deisopentanizer operating at a pressure of 55 p.s.i. and a top temperature of 174°F. A reflux ratio of approximately 12 to 1 is maintained on this column, giving an overhead product of 95 per cent plus pure isopentane. Low-pressure steam is supplied to the external reboiler (3,250 sq. ft. of heating surface) through a rate of flow controller which is reset by temperature controller operating from the temperature on the forty-fifth tray. The reboiler temperature is approximately 205°F.

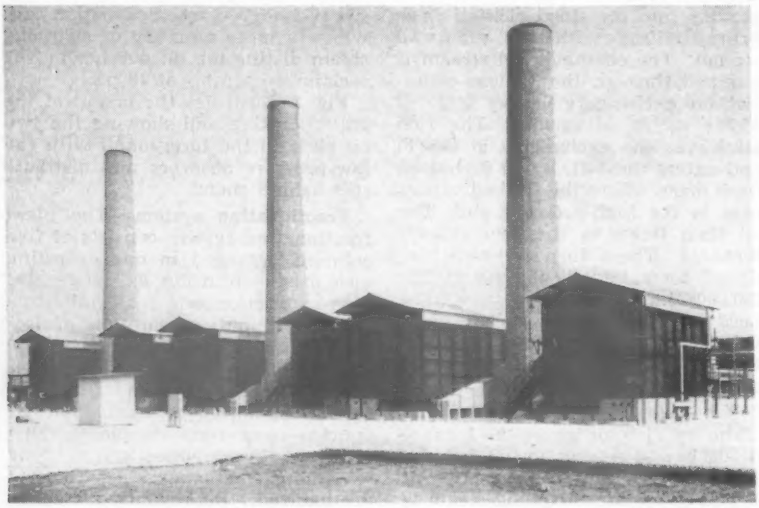


Fig. 15: Direct-fired furnaces

Metering and Storage System

The individual isopentane, mixed butanes and 400-i.b.p. distillate streams are each metered through two positive displacement meters operating in series. Complete facilities are installed for proving these meters periodically. The three streams leaving the meter flow through back-pressure regulators into a common header and into a 7-ft. by 14-ft. refrigeration flash drum operating at 3-in. Hg. vacuum where the combined liquid stream is cooled to 55°F. by the flashing of its vapors. These vapors enter the refrigeration recompressor system and are returned through a condenser to the flash drum. The cooled liquid is pumped to the two 55,000-bbl. atmospheric storage tanks where it is stored as No. 1 product.

The hydrocarbon composition of each filled tank is determined directly from the metered volumes and hydrocarbon analyses of the individual product streams. Batch shipment of the No. 1 product is made through a crude-oil pipe line to the refinery.

The two 55,000-bbl. atmospheric storage tanks have individual vapor-recovery systems to prevent loss of butane and isopentane vapors liberated by absorption of atmospheric heat. Each of these systems has a 14-in. by 13-in. 60-h.p. engine-driven compressor taking suction through a back-pressure regulator on the tank and compressing the vapors to 45 p.s.i. The vapors are then condensed and returned to their respective tanks.

The deisopentanizer and depentanizer bottoms are combined as previously indicated to form a deisopentanized 400°-e.p. gasoline. This stream which is called No. 2 product is stored in two 10,000-bbl. bolted atmospheric storage tanks. From there it is pumped by two turbine-driven eight-stage centrifugal pumps to a nearby barge-loading point for barge shipment. These pumps are manifolded to a 4-in. return line to the suction of the spare lean-oil pump which in turn is manifolded to the liquid-injection system so that the No. 2 product can be injected for storage if necessary.

Three 9-ft. by 60-ft. propane storage tanks are now in the process of installation to facilitate the tank-car shipment of propane.

A 1,000-bbl. bolted storage tank is provided for absorption-oil storage (Fig. 10 shows vapor recovery unit, 1,000-bbl. and the two 10,000-bbl. tanks).

Fuel Gas System

Approximately 11,000,000 cu. ft. per day of fuel gas is required by the plant and field. About 6,500,000 cu. ft. per day of this gas is supplied by the residue gas from the low-pressure absorber. The remaining fuel gas requirement is furnished from the 400-p.s.i. recompressor system through a reducing pressure regulator.

This system is so designed that even under unusual variations of fuel requirements no gas is flared as the recompressor system has sufficient capacity to handle the full volume of 400-p.s.i. gas.

Steam System

Three 480-h.p. water-tube boilers supply approximately 95,000 lb. per hour of 235-p.s.i. steam to the plant for power and process requirements.

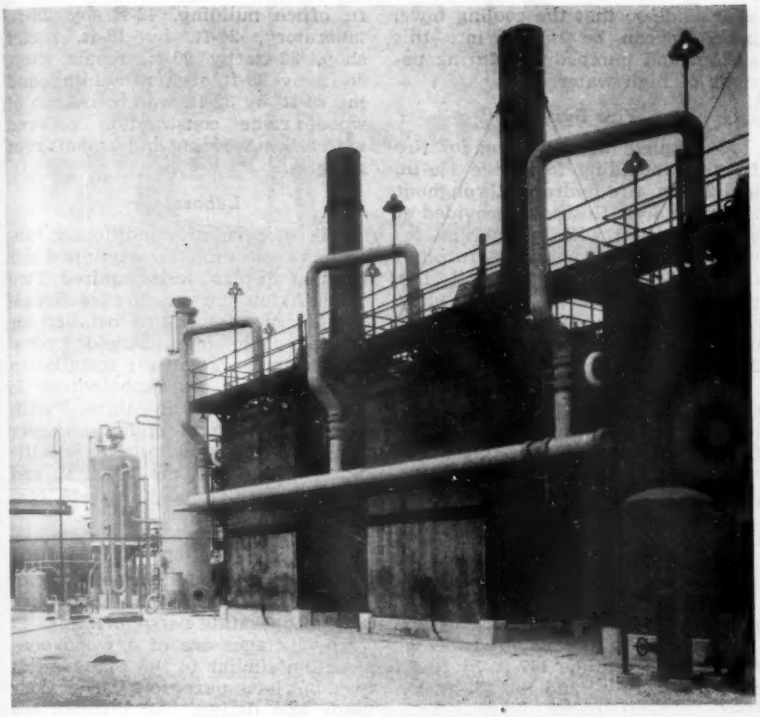


Fig. 16: Rear view of boilers and water-softening equipment

All steam turbines and reciprocating pumps in the process area exhaust into one of two auxiliary steam headers. These headers, operating at 100 p.s.i. and 30 p.s.i., supply steam to the various units for stripping and reboiling duties. Any excess steam from the 30-p.s.i. system is automatically exhausted to the atmosphere.

Steam condensate is returned to the boiler plant through a 10-ft. by 40-ft. oil skimmer tank. The plant is operating at present with approximately 80 per cent return condensate.

Boiler-Plant Auxiliaries

A 40 g.p.m. capacity hot process lime-soda softener supplies treated makeup water for the boilers. The makeup water from the softener and the return condensate from the skimmer tank are pumped into an atmospheric deareating 6-ft. by 26-ft. six-tray strip heater where they are contacted with exhaust steam for heating and stripping of dissolved air. The turbine-driven two-stage centrifugal boiler feed pump takes suction from this vessel.

Electrical System

Electricity is supplied to the plant and cottage area by two six-cylinder gas-engine - driven 75-kw 480 - volt three-phase electrical generators. (Fig. 11.) Plant power requirements are low because of the large number of gas-engine drivers provided. A few small electric motors are located in the boiler plant and building areas. All lights throughout the plant area are the overhead downward reflector type and meet U. S. Army dimout regulations. Fluorescent lighting is used in the laboratory and office building.

Water System

Wells.—Four water wells located near the outer edges of the 80-acre-plant tract supply approximately 6,000 g.p.m. of well water to the plant. All wells are completed in the same sand at a depth of 290 ft. Conventional 16-in. two-stage deep-well turbine pumps driven by 100-h.p. multicylinder gas engines are used.

Low - temperature cooling. — The well water enters the plant through four 12-in. lines and flows into a header system looping the process area. The water has a temperature of 71°F. and is used for cooling and condensing duties where low temperatures are required. Shell-and-tube heat exchangers are used for this service with an average temperature rise on the water of 8°F. The water from these units flows into the cooling tower distributing trough at certain locations where additional cooling is advantageous.

Cooling tower.—The cooling tower is an atmospheric type having 15 decks and 110 bays. The tower is 660 ft. long, 24 ft. wide and 58 ft. high including the 11-ft. coil shed. Approximately 20,000 g.p.m. of water are circulated over the tower by five engine-driven centrifugal pumps located in individual houses evenly spaced along the front of the tower. The cooling tower and pump houses are shown in Fig. 12.

The cooled water is distributed through spray headers over the atmospheric sections located in the coil shed at the base of the tower. Atmospheric sections of both the vertical and horizontal type are used.

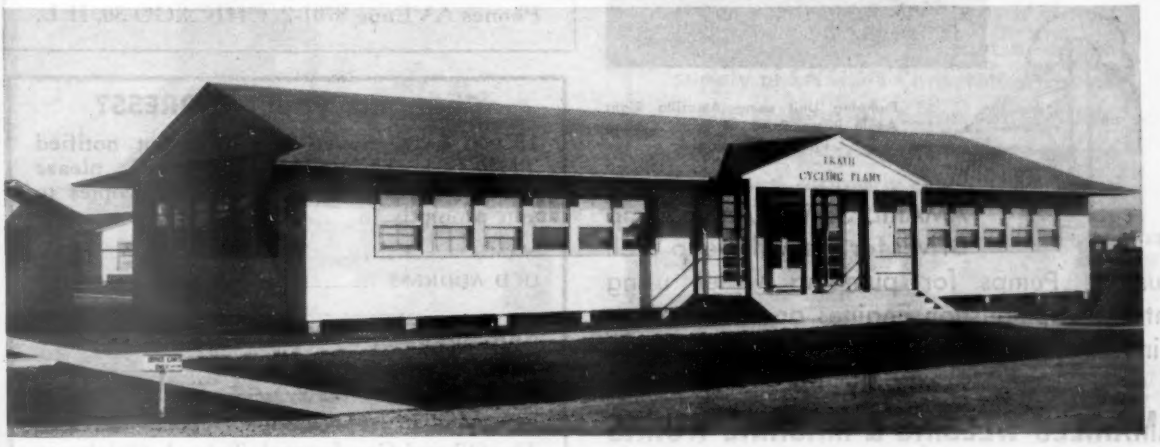


Fig. 17: Main office building

These sections have a total effective surface area of 66,200 sq. ft. and release approximately 240,000,000 B.t.u. of heat per hour from the following services: Inlet gas coolers, recompressor coolers, jacket-water coolers, still and fractionator overhead condensers, and lean-oil coolers.

Two overflow weirs in the concrete collecting basin control the overflow of nearly 6,000 g.p.m. of excess water produced by the addition of the well water from the subcoolers to the tower. This water flows from weirs by natural drainage into a nearby drainage canal.

Drainage System

Due to the proximity of the plant to the coast line, its low elevation and the danger of seasonal hurricanes, the plant area is completely enclosed by a 3-ft. dike to alleviate the danger of possible flood waters. The plant yard is graded to provide drainage of all rain water into a catch basin in the southwest corner of the plant. During normal conditions the drainage water flows by gravity from this basin into the drainage canal. However, two gas-engine-driven 12,000-g.p.m.-capacity flood pumps are housed just above the basin and pump out all drainage in case it is necessary to close the gravity drain because of high water level in canal. Provision is also made so that the cooling tower overflow can be turned into this system and pumped out during periods of high water.

Fire System

A complete water system for fire fighting including forty-five 1½-in. and 2½-in. fire hydrants throughout the plant area. Hoses are provided at every hydrant with fog nozzles located at strategic points. A turbine-driven 800-g.p.m. centrifugal fire pump located in the boiler plant area is kept ready for instantaneous operation. The pump discharges at 200 p.s.i. pressure.

Small shelters in each of the operating areas house ten 40-gal. foamite carts and numerous 2½-gal. foamite extinguishers are placed in sheltered locations throughout the plant.

The laboratory is equipped with CO_2 extinguishers.

Plant Buildings

There are eight buildings in the plant of steel frame construction covered with corrugated transite. Among these are the 483-ft. by 30-ft. compressor house and the 155-ft. by 40-ft. lean-oil pump house. Two buildings are of wood-frame construction, but also covered with corrugated transite. All remaining buildings including the 92-ft. by 36-ft. office building, 42-ft. by 28-ft. laboratory, 24-ft. by 16-ft. meter shop, 32-ft. by 20-ft. repair shop, 56-ft. by 20-ft. locker building and the 80-ft. by 32-ft. warehouse are of wood-frame construction covered with asbestos siding and asphalt roof shingles.

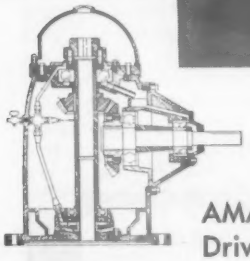
Laboratory

The modern air-conditioned laboratory is completely equipped for running all plant tests required. Two C.N.G.A. low-temperature fractional-distillation columns are installed for making all plant and field hydrocarbon analyses and the installation of an infrared spectrophotometer is planned for the near future. Facilities for analytical analyses, water analyses, charcoal tests, specific gravity measurements, A.S.T.M. and Hempel distillation, gum tests, etc., are available.

Camp

A modern camp site consisting of eight cottages is provided for key men in operating personnel.

The cottages are of a wood construction similar to the plant buildings, but have purposely varied floor plans and design. All utilities are supplied from the plant. The cottage area is enclosed by a 3-ft. dike for flood protection with connecting drains to the plant flood pumps.



Pumping Unit using Amarillo Right Angle Pump Drive at Erath Cycling Plant at Erath, La.

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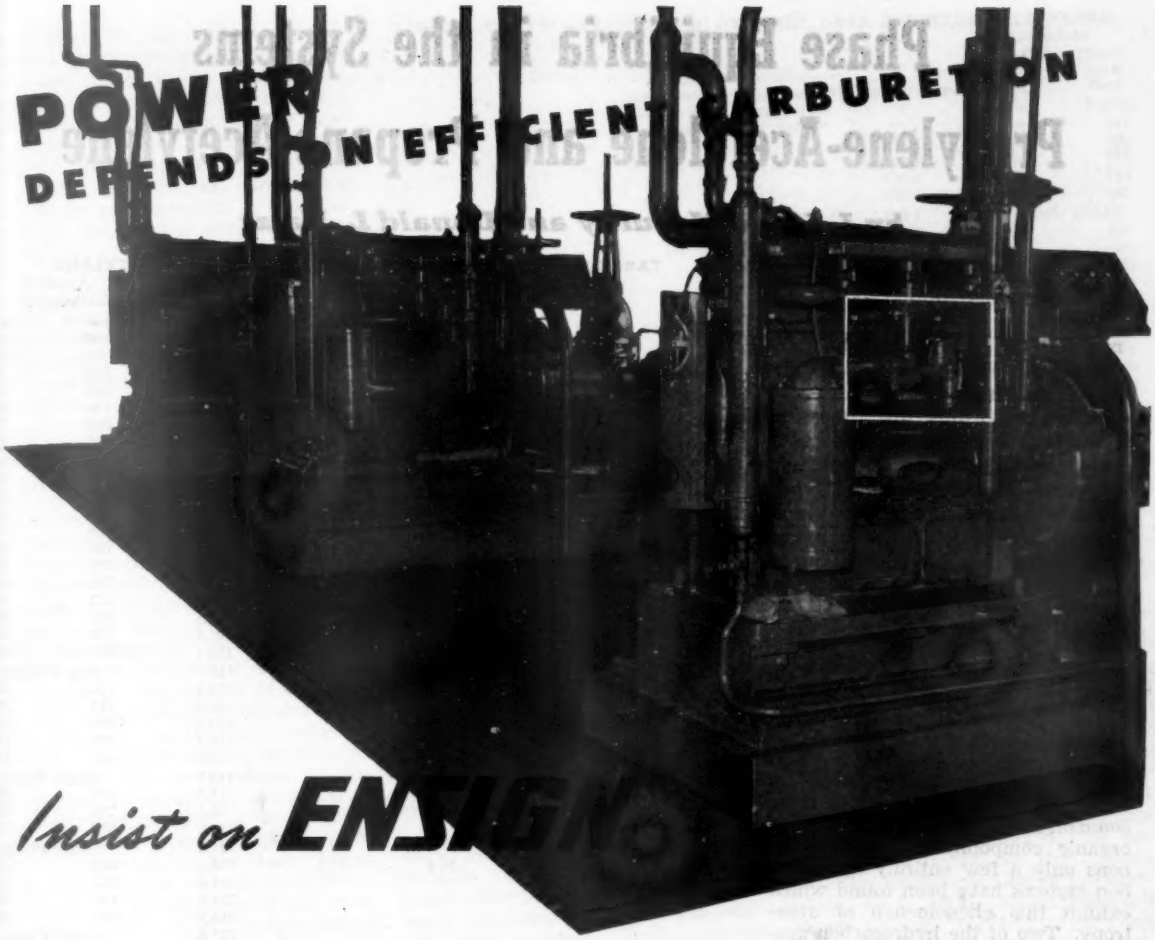

The picture above shows ENSIGN Carburetion Equipment installed on engines at the Erath Plant, largest cycling plant in the world, where 220 million cubic feet of gas is processed daily.

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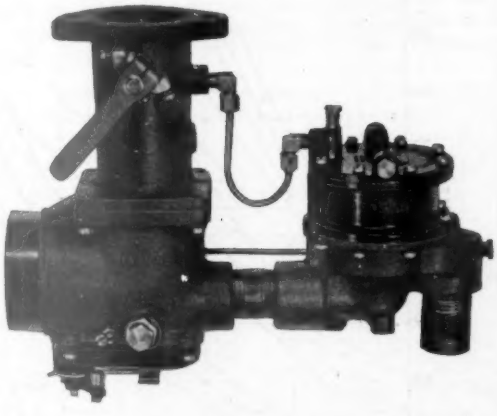

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Phase Equilibria in the Systems Propylene-Acetylene and Propane-Acetylene

*by J. Lloyd McCurdy and Donald L. Katz**

ABSTRACT

Bubble points and dew points have been determined for five mixtures of propylene and acetylene. The border curves for these mixtures and temperature-composition diagrams are presented graphically. Unlike ethane-acetylene and ethylene-acetylene systems, the systems formed by propane-acetylene and propylene-acetylene do not show constant boiling, i.e., azeotropic mixtures, as proved by the data included in this article.

THE phase behavior of the hydrocarbons has been the subject of a great amount of research in recent years with the largest amount of the work being on binary systems. Although the existence of constant boiling mixtures is quite common in binary mixtures of polar organic compounds and hydrocarbons only a few entirely hydrocarbon systems have been found which exhibit this phenomenon of azeotropy. Two of the hydrocarbon systems which exhibit this "abnormal" behavior are the ethane-acetylene[2] and the ethylene-acetylene[1] systems. Recently the existence of an azeotropic locus throughout the ternary system ethane-ethylene-acetylene was reported[4]. Inasmuch as the ethane-ethylene system has been demonstrated[8] to be of the normal type, it is apparent that acetylene is the compound which in these mixtures introduced the abnormal behavior.

The present investigations were

*University of Michigan. Present address of McCurdy, The Dow Chemical Co., Midland, Mich.

TABLE 1—SUMMARY OF ORIGINAL DATA PROPANE-ACETYLENE

	Sample Composition Mol Fraction Propane	Sample Composition Mol Fraction Acetylene	Temperature (°F.)	Absolute Pressure p.s.i. Bubble Point	Absolute Pressure p.s.i. Dew Point
Run No. 1	43.3	56.7	50.0	398	204
			81.9	546	348
			112.0	730	538
			134.2	895	786
			138.6	925	855
			143.2	Single Phase	
Run No. 2	86.0	14.0	124.9	418	302
			143.4	510	380
			165.6	618	485
			183.6	709	595
			193.3	758	670
			195.0	772	690
			197.0	782	715
Run No. 3	23.7	76.3	59.9	512	425
			81.4	635	550
			101.4	790	685
			110.1	865	805
			115.4	Single Phase	
Run No. 4	51.4	48.6	60.1	414	251
			81.6	515	305
			100.7	620	405
			115.6	705	470
			138.3	844	640
			149.1	Single Phase	
Run No. 5	29.7	70.3	71.0	544	390
			98.6	736	620
			114.6	862	756
			124.3	Single Phase	
Run No. 6	54.6	45.4	118.4	689	461
			137.4	805	620
			154.4	887	790
			155.9	894	800
			157.9	Single Phase	
Run No. 7	16.60	83.4	74.8	623	550
			100.1	836	755
			104.3	891	850
			109.3	Single Phase	

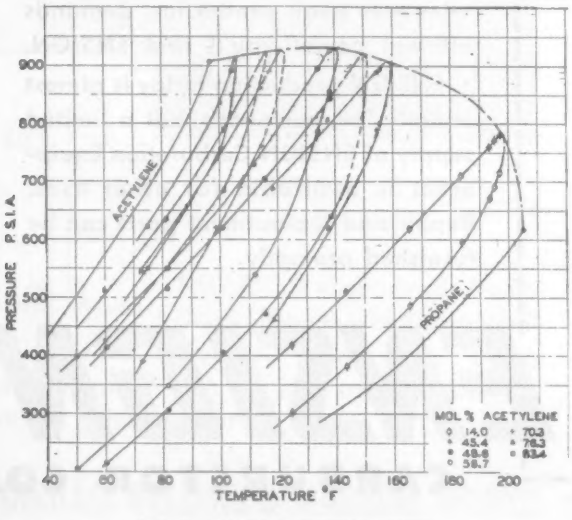

Fig. 1—Acetylene-propane system

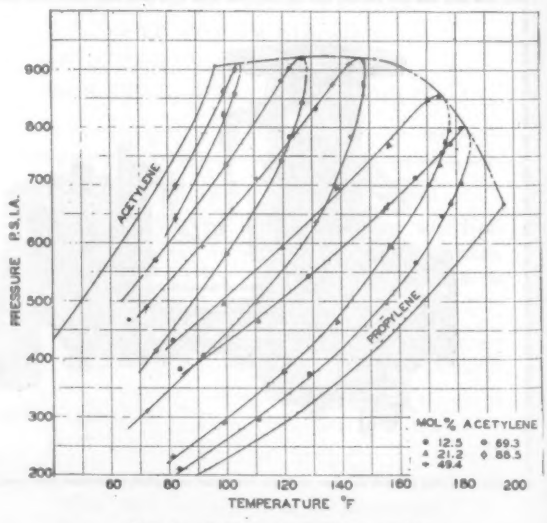

Fig. 2—Acetylene-propylene system

undertaken for the purpose of expanding the knowledge of the phase behavior of acetylene thus permitting a better insight into the underlying factors which cause this type of phase behavior. Propylene and propane were chosen to be studied in binary systems in conjunction with acetylene inasmuch as they extend the data on the phase behavior of acetylene to the next higher members of the olefin and paraffin series.

The border curves between the single phase and two phases were determined for seven compositions of propane and acetylene and for five compositions of propylene and acetylene.

Method

The technique employed in this investigation was the familiar dew-and-bubble-point method. This method consists of introducing a mixture of the components to be investigated into an evacuated equilibrium vessel of variable volume. While maintaining the entire system at a constant temperature the volume is varied and the pressure is observed at which condensation commences and is complete. By means of a series of such constant-temperature runs the dew-and-bubble-point envelope curve is obtained for the sample introduced. The composition is determined by analyzing a sample of the mixture when it is in a single phase, either upon charging or at the completion of the run. These envelope curves are obtained for a number of mixtures and by cross plotting the complete vapor-liquid equilibrium conditions may be determined.

The apparatus used for the present investigations has been described in a previous article[4]. Pressures were measured with a calibrated Bourdon tube gage with an accuracy of ± 2 p.s.i. The temperature was maintained constant at the desired level through the use of a thermostatically controlled air bath and the determination of the temperature by means of a double-junction copper-constantan thermocouple embedded in the metal of the equilibrium vessel reduced the error in temperature measurement to ± 0.1°F.

Ordinary gas absorption methods were used for the analysis of the samples of the mixtures investigated. The acetylene was preferentially absorbed in potassium-iodomercurate solution. Approximately 100 ml. of gas sample were taken for analysis. Mercury was the confining fluid with a covering layer of acid sodium sulfate solution to prevent attack on the mercury by the acetylene in the samples. The propane or propylene remaining after acetylene absorption was checked occasionally for complete acetylene removal by combustion analysis. Two check analyses were run on each sample to insure accuracy.

The acetylene used was obtained from an ordinary Prest-O-Lite welding cylinder. Analysis of this supply showed a purity of 97.5 per cent acetylene with 2.44 per cent nitrogen, 0.05 per cent oxygen, 0.01 per cent carbon monoxide. Purification consisted of liquefaction of the acetylene in a small asbestos-packed vessel through the use of dry ice and acetone, venting the uncondensed gases off with a considerable quantity of acetylene and subsequent transfer of the purified acetylene to the equilibrium vessel.

The propane used was contributed by Phillips Petroleum Co. The purity was given by the company to be not less than 99.9 mol per cent propane. It was used directly from the cylinder as obtained.

Propylene used in the present investigations was purchased from

TABLE 1 (CONT'D)—SUMMARY OF ORIGINAL DATA PROPYLENE-ACETYLENE

	Sample Composition			Absolute Pressure	
	Mol Fraction Acetylene	Mol Fraction Propylene	Temperature (°F.)	p.s.i. Bubble Point	p.s.i. Dew Point
Run No. 1A	.693	.307	75.5	570	414
			100.4	735	580
			119.6	880	742
			122.4	902	784
			126.9	920	842
			129.4	Single Phase	
Run No. 2A	.494	.506	72.3	490	310
			91.9	595	405
			110.6	710	498
			131.3	832	636
			137.8	875	700
			143.1	910	784
			148.0	915	855
Run No. 3A	.212	.788	81.2	440	233
			99.1	495	290
			119.8	592	364
			138.4	695	475
			156.8	768	595
			170.3	847	700
			174.6	855	735
			176.1	857	775
			177.3	fogg	796
Run No. 4A	.125	.885	83.4	382	210
			110.9	465	295
			128.4	542	375
			155.6	662	498
			165.8	712	565
			175.0	758	648
			178.0	771	669
			181.8	800	702
Run No. 5A	.8855	.1145	82.4	698	642
			99.9	860	820
			103.8	900	857
			109.8	Single Phase	

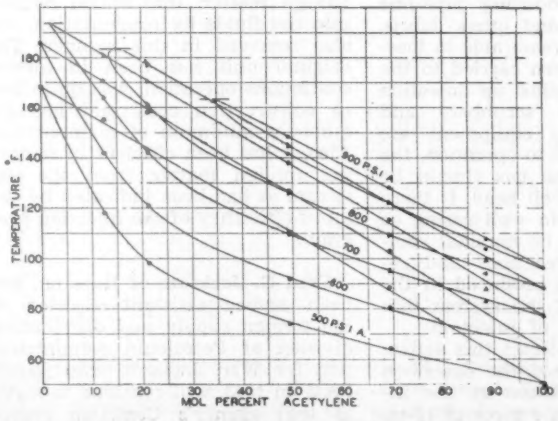

Fig. 3—Vapor-liquid compositions for acetylene-propylene system

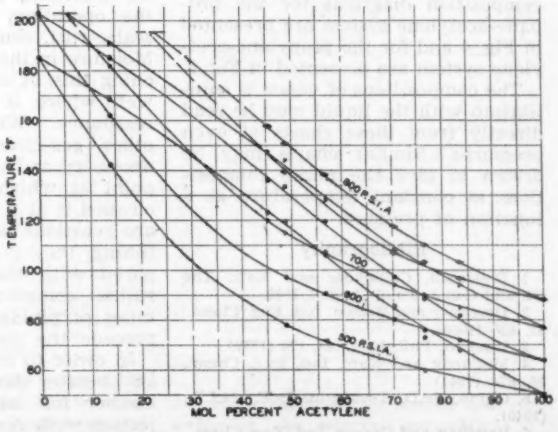

Fig. 4—Vapor-liquid compositions for acetylene-propane system

Phillips Petroleum Co. and its purity was given as not less than 99 mol per cent propylene. This was also used directly from the cylinder as purchased.

Results

The experimental investigations were conducted over the pressure range from about 200 p.s.i. absolute to above the critical pressure of the system and over the temperature range between 50°F. and 197°F. A summary of the original data is presented in Table 1. The compositions of the mixtures investigated were determined as previously described by analyzing samples of the mixture taken upon completion of the experimental determinations. The temperatures listed in the table are the average of the constant temperatures of the individual bubble-and-dew-point determinations. In no case did the actual temperature during the runs vary more than 0.6°F. from the average value reported. The bubble-and-dew points reported in the table were obtained by plotting the total volume versus the pressure and the volume per cent liquid versus pressure. The break points of such plots determine the dew point and the bubble point of the sample under investigation to within 5 or 10 p.s.i. in most cases. In one or two cases the uncertainty may have been as high as 40 lb.

The data presented in Table 1 are plotted on pressure-temperature diagrams in Fig. 1 for the propane-acetylene system and in Fig. 2 for the propylene-acetylene system. The vapor-pressure data for propane and propylene were from references (2) and (6) respectively. It should be noticed in both figures that all two-phase mixtures of the two components whose phase behavior is presented in the figures lie within the temperature limits of the vapor-pressure curves of the pure components. These figures show clearly that the systems under investigation contain neither maximum nor minimum boiling mixtures.

A group of isobaric temperature-composition diagrams for the propane-acetylene system are presented in Fig. 4 and for the propylene-acetylene system are presented in Fig. 3.

The compositions of vapor in equilibrium with the liquid may be read directly from these charts at even pressures. Similar charts may be drawn to give the phase compositions at constant temperature as a function of pressure.

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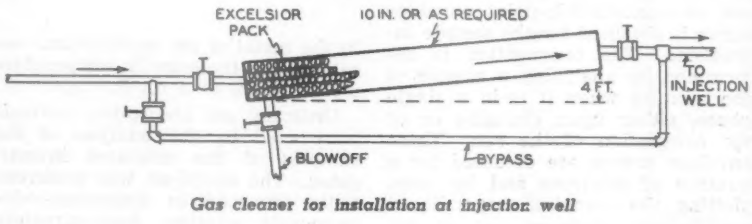
Practical, Economic Method of Reconditioning Gas for Injection

by Frank B. Taylor

A CONSTANT hazard in the operation of air or gas-injection wells is clogging of the formation. This action increases the pressures required to force the gas into the formation, reduces input volumes, decreases over-all efficiency of the project in general, and increases operating costs. It is sometimes difficult to trace to its actual source as the results may appear to indicate other and more serious trouble. Experiment has developed a device that has proved highly practical in reducing this hazard to a minimum.

One unit designed for use on a gas-injection well in Zapata County, Southwest Texas, has been in operation more than 2 years while another similar unit built and installed near Graham, North Texas, has been equally efficient over a shorter period of time. In both cases the units are handling gas to input wells into relatively shallow formations. Maintenance costs have been negligible.



Gas cleaner for installation at injection well

Well Head Is Vital Point

Sulfides, oxygen, and other materials carried with air or gas used for injection, attack equipment on the operation, producing pipe-line scale, rust, dust, and other debris. Moisture in the stream aids in loosening this. It is then carried to the well where it builds up injection resistance. While scrubbers and other gas-cleaning equipment are necessary and vital to operation, the point at which the gas should be cleaned is at the well head. If there are reactions within well casing or tubing, they must be nominal compared with the reactions and resultant compounds produced in the miles of piping of the system that precede the point of injection.

In order to counteract this action, an operator designed the described cleaner for installation at the injection well. A single piece of 10-in. pipe was used, with heads cut for both ends. Into each head was welded a short, threaded nipple, and near the end of what was to be the bottom and upstream end of the 10-in., another threaded nipple was welded. One head was then welded in place, the pipe filled with excelsior, and the other head welded into the cleaner.

Gas entering the cleaner did so from a smaller lead line and so it expanded considerably upon entering the larger pipe. This allows a reduced rate of flow, and permits matter carried by the gas to drop out. Dust, iron sulfide, scale, sand, and other material are found to accumulate in the excelsior. Also, the unit acts much in the manner of an inefficient separator for it collects water, oil and distillate in the upstream end of the device which is supported in such a manner that it tilts up in the direction of the gas flow so that its downstream end is 4-4½ ft. higher than the upstream end.

Accumulating fluids are regularly blown off through the previously mentioned nipple in the bottom of the unit, this being done through a plug valve. Some dirt and other foreign matter, that which washes into the fluids by condensation, are also removed in this manner. The original unit has been in almost continuous operation, was quite low in construction cost, and has required a minimum of maintenance. Also, it has been efficient in removing foreign matter from the gas stream as had been indicated by the input efficiency of the injection program.

Fred G. Jackson, of Houston, has been named assistant director of the foreign supply and distribution division of Petroleum Administration for War. Jackson, who joined PAW in 1943, will continue to serve as that agency's Canadian representative.

Displacement of Oil by Water From a Point

*by Park J. Jones**

Mechanics of Producing Oil, Condensate, and Natural Gas

PART 20 OF A SERIES

Oil is displaced by water daily in hundreds of reservoirs. The source of the water may be bottom water, edge water, or injected water. Oil can be displaced because of pressure differences. It can be displaced also by gravity. But the effect of gravity, which can be the principal cause of oil displacement in some reservoirs, is not considered in this article.

The permeability of media to a fluid at less than 100 per cent saturation is called effective permeability. The ratio of effective permeability to the permeability at 100 per cent saturation is called relative permeability. Relative permeabilities to water and to reservoir liquids are used in estimating displacement of oil by water. Many oil reservoirs contain more than a million barrels of reservoir space. One barrel of reservoir space is commonly less than one millionth part of a reservoir. Data referred to 1 bbl. of reservoir space are called point data. This article is limited to displacement of oil by water from a point.

Experimental Relative Permeability

ILLUSTRATED in Fig. 20-1 is the relative permeability obtained experimentally for some unconsolidated sand. The permeability of the sand in the experiments ranged from 1,040 md. up to 6,800 md. The relative permeabilities of a given media vary quickly with saturation. In Fig. 20-1, the relative permeability to a reservoir liquid at 70 per cent saturation is about 50 per cent. At 20 per cent reservoir liquid saturation, it is less than 1.0 per cent.

The sum of relative permeabilities is less than unity. In the figure, $K_L + K_w$ is equal to only 32 per cent at about 55 per cent water saturation. Relative permeabilities also vary with the characteristics of pays. The relative permeability to a reservoir liquid at a given saturation in a sand pay may be different from that in a sandstone or a limestone pay at the same saturation.

Interstitial Water vs. Oil Recovery

Recovery of oil by displacing reservoir liquids with water depends on the characteristics of pay. But pay characteristics are such that their interstitial water content ranges from about 5 per cent up to about 65 per cent. Some of this 13-fold variation may be attributed to differences in viscosity between reservoir liquids. But most of the variation is believed to be caused by the composition and texture of the media in which oil is found. The effect of differences in water-reservoir liquid interfacial tensions that are found in practice are thought to be negligible.

It is believed that interstitial water gives more information than any other single parameter on (1) the quantity of oil in place, (2) oil recovery by water displacement, (3) available rate of oil recovery by water displacement, and (4) the composition of the production as to per cent water in the production by water displacement. Accordingly, interstitial water is used as a factor in estimating oil recovery by water displacement.

Computed Relative Permeability

Fig. 20-2 illustrates computed relative permeability (K_L) to reservoir liquid and (K_w) to water for 10 per cent interstitial water and 40 per cent interstitial water respectively. The curves in this figure are solutions of the following equations:

$$K_L = \left(\frac{0.9 - W}{0.9 - I}\right)^2 \qquad (1)$$

and

$$K_w = \left(\frac{W - I}{1 - I}\right)^n \qquad (2)$$

where

W = total water saturation, fraction of porosity

I = interstitial water, fraction of porosity

K_L and K_w = relative permeability to reservoir liquid and to water

Derivation of Permeability to Water

Let the relative permeability to water for displacement of reservoir liquid by water be defined by:

$$K_w = y^n \qquad (3)$$

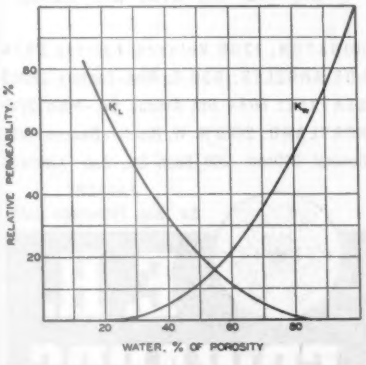


Fig. 20-1—Experimental relative permeability (K_L) to reservoir liquid and (K_w) to water in unconsolidated sand. Data by Leverett

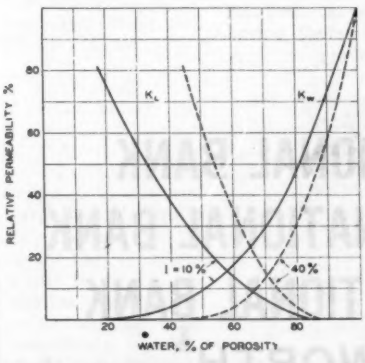


Fig. 20-2—Computed relative permeability (K_L) to reservoir liquid and (K_w) to water for 10 per cent and 40 per cent interstitial water

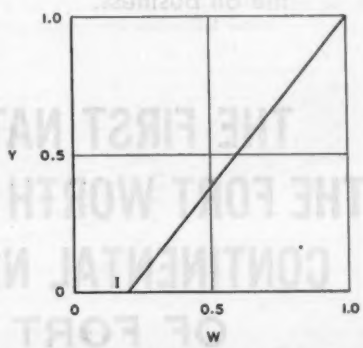
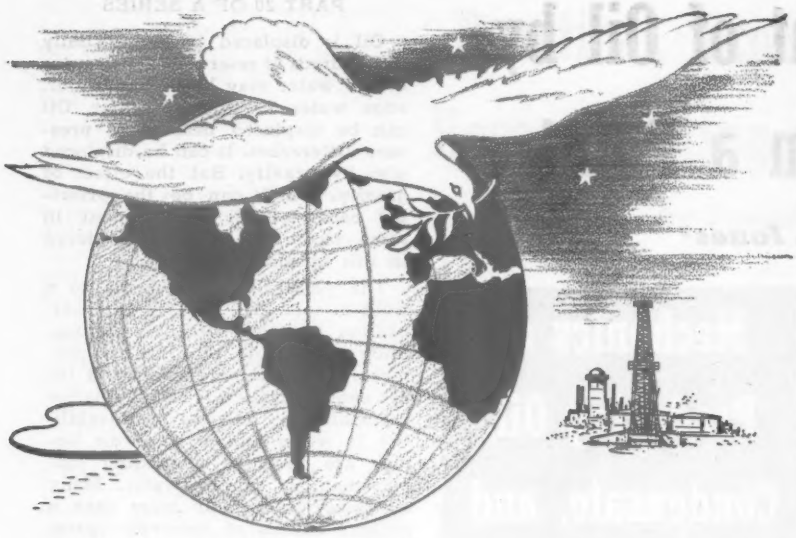


Fig. 20-3—Illustrating the method used for estimating the relative permeability to water

*Production consultant, Houston.



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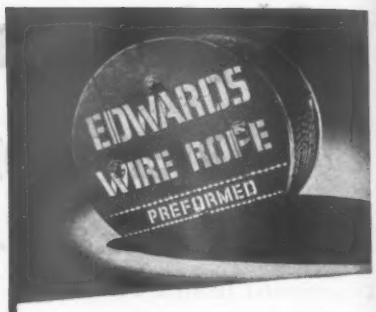

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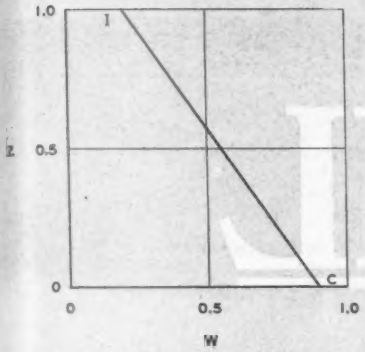

Fig. 20-4—Illustrating the method used for estimating the relative permeability to reservoir liquid displaced by water

where
y = a quantity to be found
n = a number

The problem is to find a quantity y which, when raised to the nth power, reproduces approximately the experimental data on relative permeability to water. The approximation need not extend beyond the limits of interest in production.

In Fig. 20-3, the relative permeability to water at 100 per cent saturation is 1. Whereas, the relative permeability at a water saturation I, equal to the interstitial water content of a pay, is assumed to be zero. The equation of a line connecting these two points is:

$$Y = \left(\frac{W - I}{1 - I}\right) \qquad (4)$$

Accordingly,

$$K_w = y^n = \left(\frac{W - I}{1 - I}\right)^n \qquad (5)$$

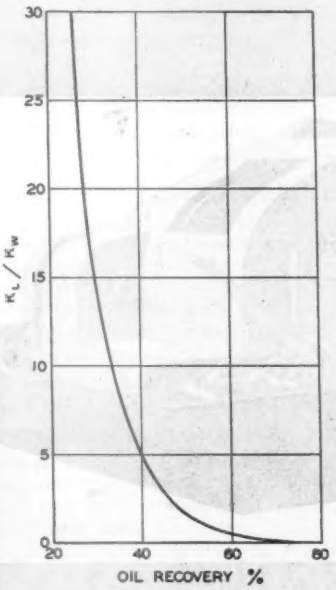

Fig. 20-5—Permeability ratio vs. per cent oil recovery from a point in a reservoir

The whole number which most nearly approximates experimental data at saturation of interest to production is n = 3. The K_w curve in Fig. 20-2 for 10 per cent interstitial water is a solution of:

$$K_w = \left(\frac{W - 0.1}{0.9}\right)^3 \qquad (6)$$

and the one for 40 per cent interstitial water, of:

$$K_w = \left(\frac{W - 0.4}{0.6}\right)^3 \qquad (7)$$

Derivation of Permeability to Reservoir Liquids

Let the relative permeability to reservoir liquid for displacement by water be defined by:

$$K_L = Z^n \qquad (8)$$

where
Z = a quantity to be found
n = a number

The problem is to find a quantity Z which, when raised to the nth power, reproduces approximately the experimental data on relative permeability to reservoir liquids. The approximation need not extend beyond the limits of saturation of interest in production.

In Fig. 20-4, the relative permeability to a reservoir liquid at interstitial water saturation (I) is assumed to be 1. Whereas, the relative permeability at water saturation (1 — c) is assumed to be zero. The quantity (c) is a correction factor for capillarity. It probably varies with the characteristics of pay and the surface properties of reservoir liquids. The equation of a line connecting the two points is:

$$Z = \left(\frac{1 - c - W}{1 - c - I}\right) \qquad (9)$$

The question now arises as to the best value for the capillary factor (c). It seems that 0.1 gives a fair fit to experimental data. This value will be used tentatively. Additional experimental data may indicate that some other value of (c) should be used. Accordingly:

$$Z = \left(\frac{0.9 - W}{0.9 - I}\right) \qquad (10)$$

The whole number which most nearly reproduces experimental data in the region of interest to production is n = 2. This curve for reservoir liquid in Fig. 20-2 at 10 per cent interstitial water is a solution of:

$$K_L = \left(\frac{0.9 - W}{0.8}\right)^2 \qquad (11)$$

and the one at 40 per cent interstitial water, of:

$$K_L = \left(\frac{0.9 - W}{0.5}\right)^2 \qquad (12)$$

Per Cent Cut in the Production From a Point

Consider 1 bbl. of reservoir space. Data for 1 bbl. of reservoir space are here designated as point data. Most reservoirs contain anywhere from a few million up to several hundred million barrels of reservoir space. Consequently, 1 bbl. of reservoir space is only one divided by more than a million which is less than 0.000001. For this reason data relative to 1 bbl. of reservoir space are called point data.

(Continued on Page 113)

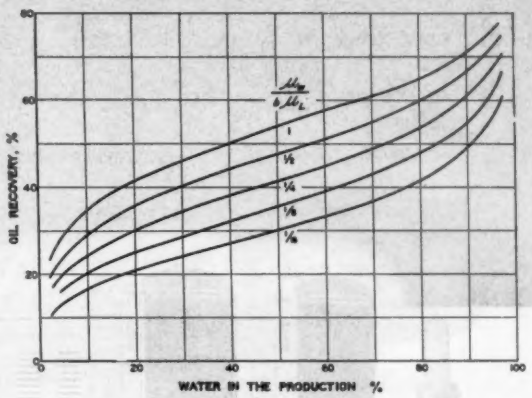

Fig. 20-6—Oil recovery from a point in a reservoir by water having displacement vs. per cent cut in the production for a pay having 10 per cent interstitial water

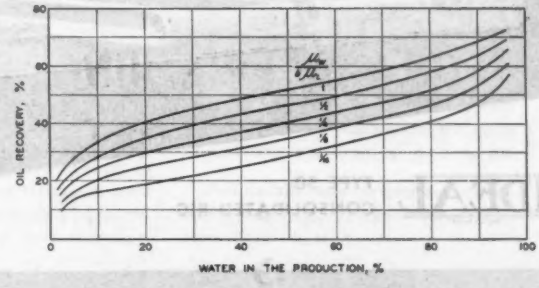

Fig. 20-7—Oil recovery from a point in a reservoir by water displacement vs. per cent cut in the production for a pay having 40 per cent interstitial water

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(Continued from Page 109)

The per cent cut in the production from a point is defined by:

$$C = \frac{100\,Q_w}{Q_w + Q_o} = \frac{100}{1 + \frac{\mu_w}{\mu_L b}\left(\frac{K_L}{K_w}\right)} \quad (13)$$

where

C = per cent water in the production
Q_w = rate of water production, bbl./day
Q_o = rate of oil production, bbl./day
μ_w = viscosity of water, centipoises
μ_L = viscosity of reservoir liquid, centipoises
b = volume factor for reservoir liquid, bbl. space/bbl. oil
K_L = effective permeability to reservoir liquid
K_w = effective permeability to water
$Q_o = Q_L/b$, where Q_L = rate of reservoir liquid production, bbl./day

Equation 13 can be derived from Darcy's law for the displacement of reservoir liquids by water. The assumptions for this equation are as follows: (1) Volume factor for water is equal to unity, (2) no reservoir gas at the point under consideration, and (3) no displacement of reservoir liquid by gravity.

Permeability Ratio vs. Oil Recovery

Equation 13 may be written as follows:

$$C = 100/(1 + AB) \quad (14)$$

where

$A = \mu_w/\mu_L b$
$B = K_L/K_w$

The quantity (B) can be expressed in per cent oil recovery from a point as shown in Fig. 20-5. The curve in this figure is obtained from the data in Fig. 20-2. These data refer to a point in a reservoir.

Oil Recovery vs. Per Cent Cut

The quantity (A) in Equation 14 depends on the viscosity and volume factor of reservoir liquids and viscosity of the water found in reservoirs. Its value commonly found in practice falls within the limits of 1 and ⅓.

Now, if we assume values for the quantity (A) and know the per cent oil recovery corresponding to a given value of the quantity (B), we can plot per cent oil recovery against per cent water in the production and obtain the curves shown in Figs. 20-6 and 20-7.

The oil recovery from a point in a reservoir can be read directly from the curves. Indirectly, the curves are used in estimating (1) the pressure differences required to achieve a given rate of oil recovery and a given ultimate recovery (2) the water saturation at which a given pay starts to produce water (3) the maximum possible oil recovery from a given reservoir by water displacement without help from gravity and (4) the minimum volume of water which has to be produced in order to achieve a given oil recovery from a given reservoir. These and other considerations will be illustrated by examples in the next article.

References

1. Leverett, M. C., A.I.M.E., TP No. 1003.
2. Muskat, M., Flow of Homogeneous Fluids, McGraw-Hill Book Co.

J. H. Russell, of Gulf Oil Corp., Houston, has been named a member of the crude-oil supply subcommittee of the general committee of District 3, Petroleum Administration for War. He succeeds **John R. Suman,** who recently was made a vice president and director of Standard Oil Co. (New Jersey) after holding similar posts in Humble Oil & Refining Co. **R. J. Gonzales,** of Humble, was made chairman of the statistical subcommittee, replacing **David G. Gray,** who resigned.

E. F. Borgolte, formerly head of the Minneapolis office of Akin Gasoline Co., has been made general sales manager with headquarters in Tulsa.

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Alignment Charts Devised for Gas Pipe-Line Operations

IN the trend toward more use of mathematics, natural-gas organizations have done much in applying accurate methods of calculation to the effective handling of a variety of operations. W. D. Parkes, of United Gas Pipe Line Co., has prepared several nomographs or alignment charts for solving common problems of foremen and others in the field. These alignment charts apply equations developed by engineers and technicians, some of which are simple while others are quite complex. Certain of the problems with which they deal recur frequently. Others which occur less often may be of considerable importance. Some require skill on the part of the computer and others do not.

Alignment charts minimize the time demands for solving recurring problems and they eliminate practically all mathematical work involved in normal solutions. The alignment chart derives its name from the fact that the key is the alignment of three points. The chart appears in a series of scaled lines with one such scaled line for each variable in the equation. When more than three variables exist, the chart also contains pivot or turning scales, which in most cases are not calibrated.

In addition to saving time, an alignment chart has further advantages since it eliminates the chance for errors of the kind that creep into long-hand computations. For routine test and control work, an alignment chart makes it possible for problems to be solved by field men without dependence on the services of engineers.

Elimination of Errors

Instead of the numerous opportunities for error in even the simplest long-hand computations, there are but two kinds of mistakes which may occur in using alignment charts: the user may misread the values on the scale or his straightedge may slip during the manipulation involved in the solution. By reducing the chance for errors to these two kinds there is elimination of mistakes in multiplying, raising a power, taking a root or carrying out any other mathematical procedure. Furthermore, the saving of time becomes more important as equations increase in complexity. Consequently the alignment charts are frequently a means of increasing the efficiency of engineers as an aid to field men.

All scales on the charts are used in groups of three and only in the manner indicated in the key of the chart. An example of this may be observed in the procedure for using the chart presented with this article for calculating pipe-line storage capacity. In order to solve the problem in the manner indicated by the key, the first step would be to apply a straightedge to the known values of D and L in order to obtain a value on X, which is not calibrated. Therefore the intersection of the line from D to L should be marked lightly with a pencil. When a value is shown on a turning point, it should be carefully noted or preferably written down on a piece of scratch paper. After doing this, the triad XVP may be solved by going from X to P to determine the point where the line crosses V. In studying the example given, the use of dotted lines may be of assistance in gaining familiarity with the method.

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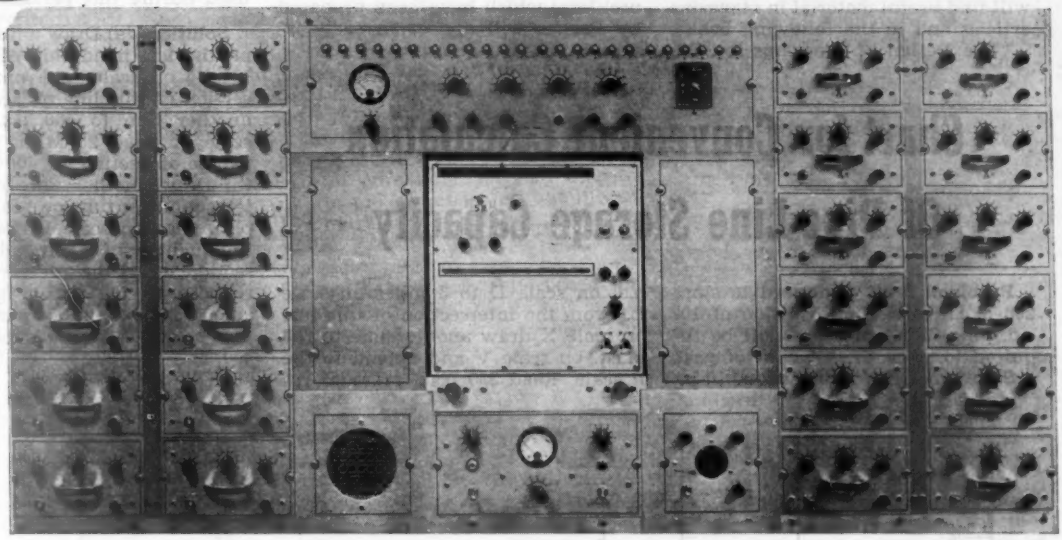

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It is possible to obtain any one of the values D, V, L, or P, if all the others are known.

The most satisfactory straightedge for use with alignment charts is a heavy celluloid one with a straight line scratched on the under side and filled with ink.

Those who wish to investigate the theory and practice of nomography will find useful material in magazine articles and in the following books:

"The Design of Diagrams for Engineering Formulas," by L. I. Hewes and H. L. Seward, McGraw-Hill Publishing Co.

"Graphical and Mechanical Computation," Vol. I, by Joseph Lipka, John Wiley & Sons.

In addition to the chart for calculating pipe-line storage capacity which is presented with this article, other charts for the solution of field problems which have been prepared by Parkes will appear in early issues.

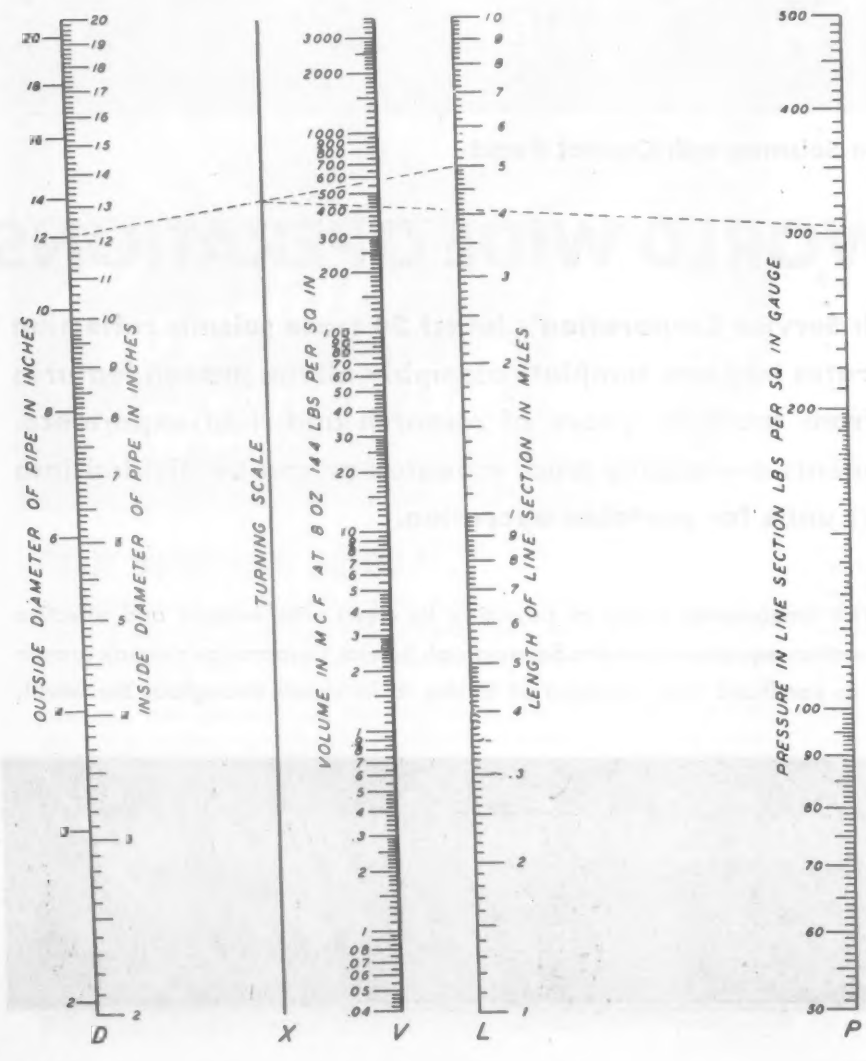
Chart for Convenient Calculation Of Pipe-Line Storage Capacity

Problem: 1—It is desired to store 200 M.c.f. in a 3-mile section of 10-o.d. pipe. What pressure will be required to store this amount of gas?

Solution: Draw a line from 10-in. o.d. on scale D to 3 miles on scale L. From the intersection of this line on scale X draw another line to 200 M.c.f. on scale V and extend to the P scale. Read 330 p.s.i. pressure required to store 200 M.c.f. of gas in a 3-mile section of 10-in. o.d. line.

Problems: (a) What is the storage capacity of 1 mile of 6-in. o.d. line if the pressure on the section is 400 p.s.i. gage? (b) How much gas will be left in the section if sufficient gas has been used to lower the pressure to 100 p.s.i.? (c) How much gas was used during this period?

Solution: (a) Draw a line from 6 in. on the left hand side of scale D to 1 mile on scale L. From the intersection of this line on scale X draw another line to 400 p.s.i. gage on scale P. Read 28 M.c.f. storage capacity of section at 400 p.s.i. gage. (b) Draw another line from the intersection on turning scale X to 100 p.s.i. gage on scale P. Read 7 M.c.f. the quantity of gas remaining in the section when the pressure has been reduced to 100 p.s.i. gage. (c) The amount of gas used during the time the pressure was being reduced from 400 lb. to 100 lb. is 28 — 7 = 21 M.c.f.


OUTSIDE DIAMETER OF PIPE IN INCHES
INSIDE DIAMETER OF PIPE IN INCHES
TURNING SCALE
VOLUME IN M C F AT 8 OZ 14.4 LBS PER SQ IN
LENGTH OF LINE SECTION IN MILES
PRESSURE IN LINE SECTION LBS PER SQ IN GAUGE
D
X
V
L
P

Formula:

V = volume in M.c.f. at 8 oz. 14.4 p.s.i.
d = inside diameter of pipe
L = length of line in miles
P = pressure in line section p.s.i. gage.

Example:

Draining 5.0 miles of 12-in. i.d. line from 305 p.s.i. gage to atmospheric pressure.

Solution:

Locate 12 in. on scale D. Connect to 5 miles on Scale L. From the intersection of this line on turning scale X. Draw another line to 305 lb. on scale P. Read 420 M.c.f. on scale V.

Key:

D X L
X V P

QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer

Filling Propane Cylinders

We are unable to find literature relating to the subject of filling liquefied petroleum gas (propane) in steel cylinders such as (1) What is the effect of air and gas mixture above the liquid? (2) What is the effect on vapor-pressure? (3) What is the minimum quantity of stock to purge a 239-lb.-water-capacity cylinder of air? and (4) Which is the better method of purging cylinders, to inject the purging stock and vent to atmosphere prior to loading the cylinders, or to overload the cylinder beyond its stock capacity and venting to the capacity set by the Interstate Commerce Commission? —E. B. H.

There are apparently no standard regulations, procedures, or rules for the filling of LPG cylinders. N.B.F.U. Pamphlet No. 58, National Board of Fire Underwriters, 85 John St., New York, entitled "Standards . . . for the Design, Installation and Construction . . . for the Handling of Liquefied Petroleum Gases" is one of the most detailed authoritative recommendations that is available and the very fact that nothing is stated directly or even implied about the filling of cylinders is clear proof of the lack of importance of this operation.

Failure to purge all of the air from the cylinder would not create an explosion hazard because the mixture so produced would be too rich to constitute an explosive mixture. In the common "one-opening" cylinders, nearly all of the air would have to be removed in order to allow the cylinder to be filled. A few operators accomplish this by partially evacuating the cylinder by means of a vacuum system, a few operators chill the cylinder to suck the first liquid into the cylinder which upon evaporation purges most of the remaining air from the cylinder, but perhaps most operators force the first amount of liquid into the cylinder by means of pressure. It is difficult if not impossible to completely fill one-opening cylinders by any of the common methods of filling. In filling sample cylinders one company recommends half filling the cylinder with liquid, allowing half of this liquid to evaporate, inverting to eliminate foreign liquids, and after repeating these purging operations three times to then fill the cylinder.

Failure to eliminate air would increase the vapor pressure slightly, particularly if filled by a pressure system, and would cause the vapor-pressure to rise somewhat more rapidly than would the vapor pressure of pure liquefied gas. Specific data could be presented but the effect on the vapor pressure is so negligible if the cylinder has been purged at all, that it may be ignored for nearly all practical purposes. The most direct effect of leaving air in the cylinder would be to lower the heating value and to alter the flame characteristics of the first gas withdrawn.

It is understood that Committee D-3 on Gaseous Fuels, of the American Society for Testing Materials (210 S. Broad St., Philadelphia) is now considering the procedure used in filling LPG cylinders.

Velocities for Heat Exchangers

What are practical minimum and maximum velocities for the fluids in exchangers and what are typical coefficients for tubular exchangers in various services?—S. K. R.

There are so many types of exchangers and conditions under which they must operate that velocity limits certainly cannot be given with any accuracy. Commercial data published on page 40, January 19, 1939, issue of The Oil and Gas Journal (Nelson, Study of Heat-Transfer Rates in Commercial Exchangers) show velocities of 0.1 to 8.05 ft. per second through the tubes, and 0.2 to 12 through the shell of the exchanger. These values are, however, probably accidental, having occurred by the switching of exchangers from one service to another, or by radical changes in the quantity of product being handled. In design work the range of velocity would probably be narrower than given above, being somewhat as 0.5 to 6 through the tubes, and 0.3 to 8 through the shell.

Such values are, however, entirely worthless because the allowable velocity is vitally dependent on the pressure drop that can be sustained and this is a variable that can confine the velocity to the low limits of the value cited above. The other or high extreme of velocity is limited to a large extent by the fact that little gain in transfer rate is attained by further increase of velocity particularly if the fouling factor is high.

Exchanger rates vary so widely for different conditions that average values are usually misleading unless they are obtained from equipments actually in service. Such data should be collected by each refiner on his particular stocks in the plant. A comparison of such rates is given on page 428 of the second edition of Petroleum Refinery Engineering (McGraw-Hill Book Co., New York) but they are not recommended except for most general purposes.

A.S.T.M. Per Cent Evaporated and Per Cent Recovered

In marketing red all-purpose gasoline we are asked to add the loss to the percentage distilled in meeting the specifications for 10 per cent and 50 per cent points. Isn't the 10 per cent point usually considered as the temperature recorded when there is 10 ml. in the receiver?—J. C. P.

Unfortunately the term "A.S.T.M. 10 per cent point" is used carelessly by many people. The situation is made clear in A.S.T.M. Designation D86-40 entitled, "Distillation of Gasoline, Naphtha, Kerosene and Similar Products" as well as Method 100.15 of Federal Standard Stock Catalog VV-L-791b. These are the main standards in this country (A.S.T.M.-210 South Broad Street, Philadelphia) and D86-40 states as follows:

"The sum of the volume collected in the cylinder at any specified temperature and the distillation loss may be recorded as the percentage evaporated at the temperature in question. Clear distinction shall be made between the inclusion and exclusion of the distillation loss figure in the report of the volume of distillate obtained at any prescribed temperature. In the first case the figure shall be reported as the volume evaporated, in the second, as the volume recovered."

The terms "per cent recovered at —°F." and "per cent evaporated at —°F." are both found in specifications but unfortunately it is common practice by plant men to consider both of these terms as "per cent recovery." Obviously from a technical standpoint the addition of the loss to the recovery at any temperature (per cent evaporatetd) is more significant than to speak of "per cent recovery" but it is a refinement whose practical significance may not justify the extra trouble (and sometimes confusion) involved.

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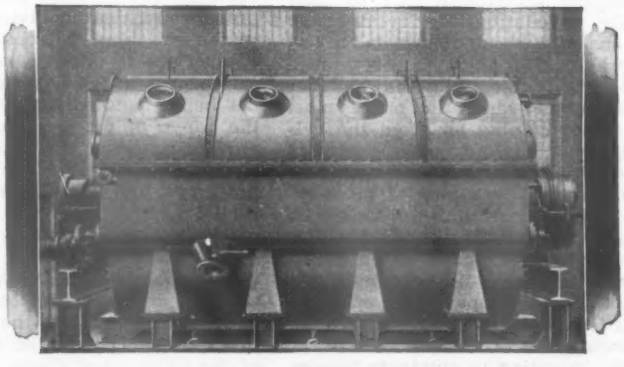

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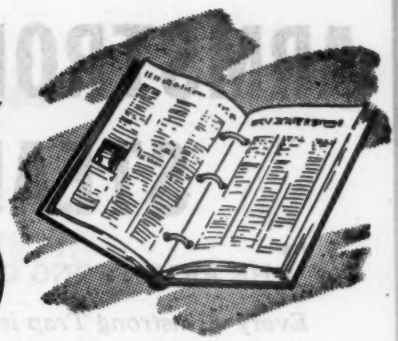

Flash Vaporization (vs. A.S.T.M.)

THE conditions under which vaporization occurs in most refinery equipment are such that equilibrium flash vaporization occurs. By this is meant that all parts of the material (even parts that may already be vaporized) are in intimate contact with one another. This permits the low-boiling parts of the solution to assist in causing high-boiling materials to vaporize. This condition does not exist in batch-type distillations (A.S.T.M., Hempel, T.B.P., etc.—see The Refinery Notebook No. 24 of December 30, 1944) because in these distillations the vapor is removed from the remaining material by collecting it into a receiver or graduate where it cannot further affect the behavior of the material remaining in the flask.

Equilibrium flash vaporization occurs whenever a material is heated (or cooled) while it flows continuously through an equipment in which vaporization or condensation occurs as in a:

1. Heat exchanger.
2. Pipe still.
3. Each plate of a fractionation tower.
4. Condenser.

Movement must be fast enough to cause intimate mixing. Equilibrium flash vaporization can also occur at a constant temperature by changes in pressure that cause vaporization or condensation.

A flash curve shows the temperature required under the equilibrium conditions indicated above, to vaporize the material. It lies across the vapor-temperature curves of A.S.T.M., T.B.P., etc., batch-distillation curves, as shown in Fig. 2. The curve is substantially straight (see Petroleum Refinery Engineering, 2nd Ed., p. 244, McGraw-Hill Book Co., Inc.) and the relationship shown here gives a straight flash curve. Each type of batch distillation is related differently to the flash curve, and the relationship to a true-boiling-point distillation will be given in The Refinery Notebook No. 37.

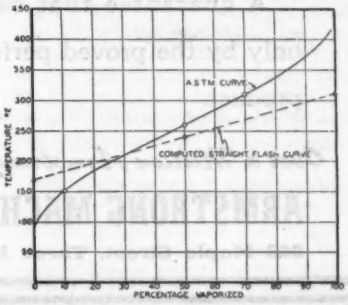

Fig. 2—Flash curve from A.S.T.M. distillation curve

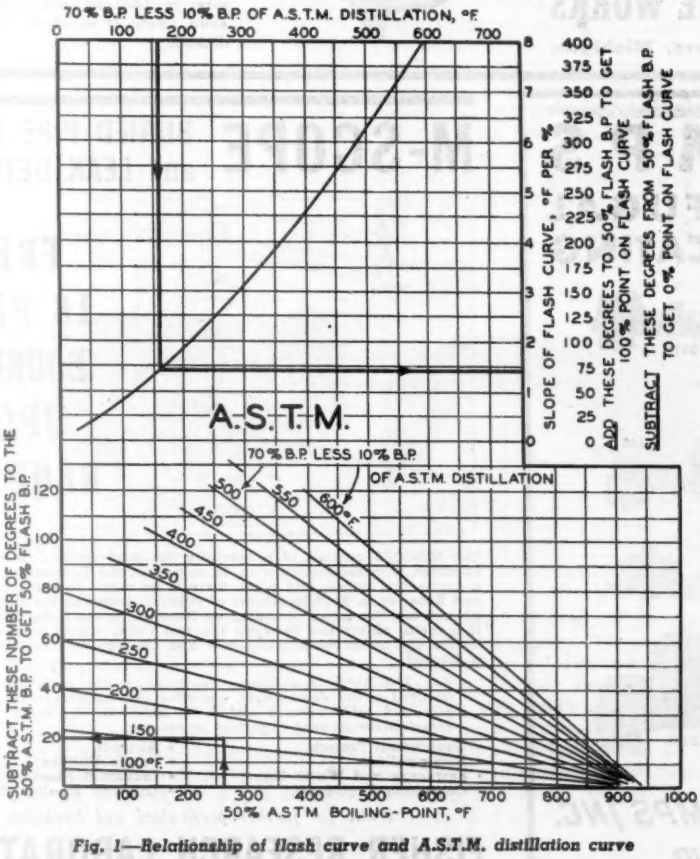
70% B.P. LESS 10% B.P. OF A.S.T.M. DISTILLATION, °F
SLOPE OF FLASH CURVE, °F PER %
ADD THESE DEGREES TO 50% FLASH B.P. TO GET 100% POINT ON FLASH CURVE
SUBTRACT THESE DEGREES FROM 50% FLASH B.P. TO GET 0% POINT ON FLASH CURVE
A.S.T.M.
70% B.P. LESS 10% B.P. OF A.S.T.M. DISTILLATION
SUBTRACT THESE NUMBER OF DEGREES TO THE 50% A.S.T.M. B.P. TO GET 50% FLASH B.P.
50% A.S.T.M. BOILING-POINT, °F

Fig. 1—Relationship of flash curve and A.S.T.M. distillation curve

Example.—The A.S.T.M. distillation curve shown in Fig. 2 has 10, 50 and 70 per cent boiling points of 150°, 260°, and 310° F. respectively.

70% — 10% temp. = 310° — 150° = 160° F.

The lower part of Fig. 1 shows that the 50 per cent flash temperature is 20° F. lower than the A.S.T.M. 50 per cent temperature or 260° — 20° = 240° F.

The upper part of Fig. 1 shows the flatness or slope of the flash vaporization curve. The slope is 1.4° per 1 per cent, and the zero and 100 per cent points on the flash curve are:

Zero per cent is at 240° — 70° = 170° F.

100 per cent is at 240° + 70° = 310° F.

No. 34 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa

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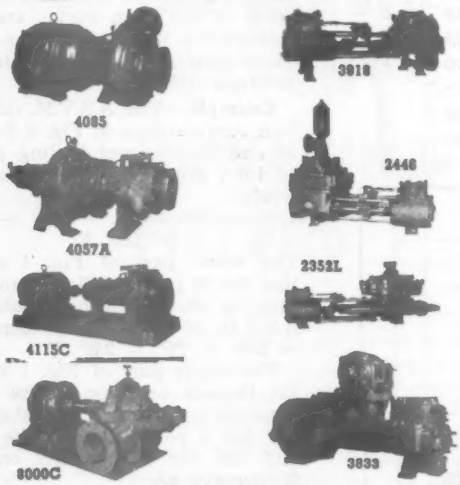

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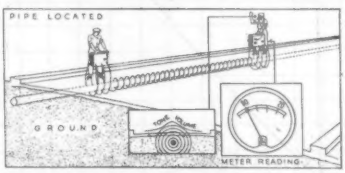

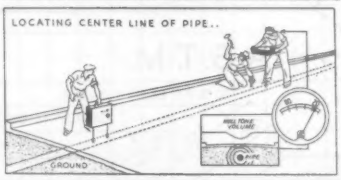

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Engineering Fundamentals

No. 177

A FEATURE OF THE OIL AND GAS JOURNAL

Application of Surface Chemistry to Oil-Production Problems

WATER ratios in wells producing both oil and water.—The fact that there is a decided difference in the surface chemistry of oil from that of water, as discussed in the four preceding chapters on Engineering Fundamentals, explains some of the puzzling problems in oil production. For example, if a hole is drilled completely through an oil sand which contains exactly 50 per cent water and 50 per cent oil, one might expect that the well would produce the two liquids in proportion to their respective viscosities. Thus if the viscosity of water is one and the viscosity of oil is one, it might be expected that oil and water would be produced in about equal proportions. As a matter of fact, however, this is rarely the case. When water has entered and filled half of the space in an oil sand, the amount of water produced in most places is much larger than the amount of oil. Wells producing from such a sand may yield as much as 95 per cent water and 5 per cent or less of oil. The reasons for this phenomenon are several.

First, in many places water appears during the later stages of production when reservoir pressures have declined so that the pressure due to the static head of oil and water in the hole is equal to the reservoir pressure. Oil is lighter than water and rises above the water in the well, so that a column of water stands opposite the oil sand in the hole. Under these conditions water may move into the capillaries between sand grains around the periphery of the hole and displace oil. How far this penetration of water will go depends upon the smallness of the capillaries and the amount of differential pressure between the column of water in the well and the reservoir pressure. The greater the pressure of the water column with respect to the reservoir pressure, the greater the penetration. The result is that a sheath of excess water may occur around the periphery of the well (Fig. 1). Once the water gets into these capillaries, due to the difference in surface tension between oil and water, the water clings to the tiny passageway and keeps the oil out. As more fluid migrates into the hole, water flows through the water-filled channels, and oil is excluded. The oil travels only through the remaining passageways still filled with oil. These are mostly at the top of the sand layer (Fig. 2). Under such conditions the water-oil ratio increases greatly, and the production of the oil fraction is reduced.

Secondly, when a sand contains as much as 50 per cent water, the greater proportion of the water is in the bottom of the sand, a mixture of water and oil in the middle of the sand, and a large proportion of the oil in the top of the sand (Fig. 3). Under such conditions, the capillaries in the periphery of sand around the edge of the hole are many times partially clogged up with paraffin and with silt and fine particles of sediment that get into the hole. Furthermore, in many places the sand is cut with

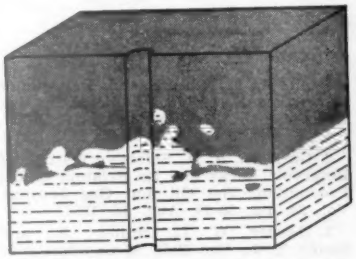

Fig. 1—Section of sand cut through a producing "oil well" showing distribution of oil and water soon after completion. Note that the contact of water and oil is not a flat plain but an irregular surface with stringers of water extending up into the oil zone. Drawing is exact copy of photograph of a section through an experimental well set up in an artificial oil reservoir in a research laboratory

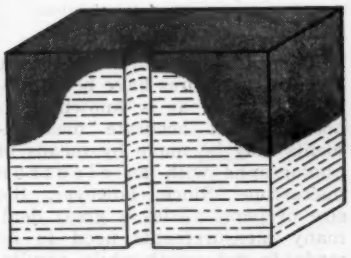

Fig. 2—Section of sand cut through an artificial experimental "oil well" after flowing rapidly for some time. Note how water has "coned" around a rapidly producing hole leaving only a small layer of sand in contact with the well. This well is producing about 10 per cent oil and 90 per cent water, although the sand contains nearly 50 per cent oil. Copy of an original photograph

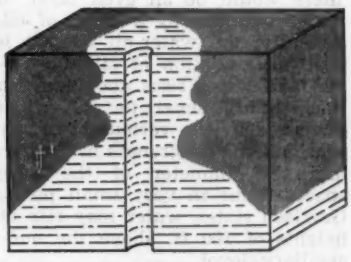

Fig. 3—Section of sand cut through an artificial experiment oil well after producing rapidly and shutting down periodically. The water "cones" and penetrates laterally into sand forming a water sheath around the well. The well is producing 100 per cent water and no oil, although the sand still contains over 50 per cent oil. Drawn from an original photograph

Series prepared by F. B. Plummer, professor, petroleum engineering school, University of Texas

vertical cracks and joint crevices so that migration of water into the upper portion of the sand around the periphery of the well takes place more easily than horizontal migration into the wells through the partially paraffin-choked openings. If the well is pumped fairly rapidly at times, water from below is drawn up through the minute cracks and other passageways into the area around the periphery of the hole and displaces the oil. Once vertical or nearly vertical passageways are established for water, the flow of liquid persists vertically, and a cone of water around the well is established (Fig. 2) which may persist even after the well is shut down, unless the spaces between the sand are so large that capillary effects are overcome by gravity. Once a "capillary-water cone" has been established, the proportion of water produced greatly exceeds the proportion of oil.

Computation of capillary effects causing water penetration into oil sands—Garrison,[2] Bartell,[1] Leverett,[4] Livingston,[5] Hassler, Bruner and Deahl,[3] and others have studied the capillary forces which play a part in oil production. Garrison concluded that the water-oil contact around a well and in a reservoir depended largely upon capillary forces and pointed out that if the reservoir were not capillary, there would be an even layer of water overlain by a layer of oil. Actually, the water-oil contact is really a gradation of oil into water, and water rises above such a noncapillary level to an extent governed by the various boundary tensions, the differences in density, and the diameter of the pore spaces. Thus in very small pores, Garrison states, water may rise at heights of 100 ft. above the noncapillary level.

Livingston, using chemically pure pentane, water, and silica in place of crude oil, water, and sand, measured the capillary force accurately, and both he and Leverett have presented formulas by which the capillary rise may be calculated. Livingston found that the spreading pressure of water, when it is in contact with oil and silica, is 51 ergs per sq. cm. This is equal to a displacement pressure of about 5 p.s.i. in a capillary of one micron radius. His equation is as follows:

$$\Delta phg = \left(\frac{1}{R_1} + \frac{1}{R_2}\right) \cdot y \cdot \text{Cos}\,\theta$$

Δp = difference between the densities of the fluids
h = height reached by the water above noncapillary level
g = gravitational constant
$\frac{1}{R_1} + \frac{1}{R_2}$ = radii of curvature of the interface between the two fluids
θ = contact angle between the two fluids
y = interfacial tension between the fluids

Many of these functions have been measured and published by Livingston and others as follows:

FACTORS AFFECTING CAPILLARITY IN OIL RESERVOIRS

Symbol	Function	Range of values	Authority
Δp	Difference in density between oil and water	0.0947 to 0.2962	Livingston
		0.219*	
θ	Contact angle between oil, water and rock	0	Hunten and Maass; Bartell and others
y	Interfacial tension between oil and water	9.6 to 19	Livingston, Hocott
R	Radius of curvature of interface between liquids	0.0125 to 0.2	See discussion below

*Average of 10 determinations.

No accurate measurements of the radii of rock pores have been published, so far as is known. It is possible that accurate measurements may be made by means of photographs with an electron microscope. Since, however, the size of pores varies a great deal, many measurements need to be made to get worth-while results. Nutting[6] has considered that the size of pore radii could be estimated by measuring the average grain size of the oil sand. He believed that the radii of the openings averaged one-tenth of the average grain diameter for sands settling in water. Since the average grain size of the Bradford sand is 0.125 mm., the average pore diameter would be 0.012 mm. Livingston has suggested a much more satisfactory method as follows: Measure the actual rise of water in a series of cores derived from an oil pool by means of an electrical-conductivity apparatus. From this factor and the other known functions needed in the above equation for capillary rise of water, solve for the size of pore radii. More investigations need to be made before actual distances of capillary rise and capillary spreading of water in oil sands can be calculated. Enough has been done, however, to know that the capillary effect of water on oil production is large. Water rises and spreads around a producing well during production of oil and depresses markedly the amount of oil produced in an oil well, making both oil and water.

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OIL AND GAS EQUIPMENT Digest

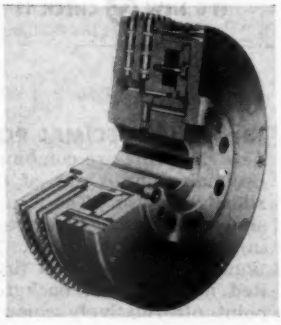
IT'S NEW CHECK IT

by Kenneth B. Barnes

(1) ALNOR VELOMETER is direct-reading, instantaneous air-velocity meter. Results are given in feet per minute without timing, calculations, or reference to tables or charts. Low-range readings are obtained by holding the Velometer in the air stream; high ranges by use of tube-connected jets. For engineering work where air conditions are important — cooling, stresses, blowing, etc. *Illinois Testing Laboratories, Inc., Chicago, Ill.*

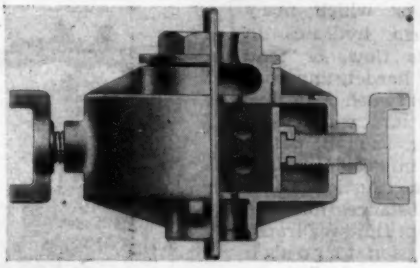
IT'S NEW CHECK IT

(2) AIR-ACTUATED CLUTCH of new design provides ideal operating characteristics because a controlled amount of air pressure can be applied to the friction plates to provide a wide range in slow to fast engagements. Permitting remote control by using only a valve and small tubing, complicated linkage systems, maintenance, resetting, and shaft space are eliminated. No lubrication is needed because the moving parts are not in contact with each other and no adjustment is required to maintain proper pressure on the friction discs. *Twin Disc Clutch Co., Racine, Wis.*



IT'S NEW CHECK IT

(3) SUCKER-ROD STRIPPER is a new item for well-servicing equipment, to keep sucker rods clean and shipshape. Light, inexpensive, easy to attach and demount, paraffin and oily accumulations are removed with a minimum of effort during pulling jobs. The rubbers are quickly retractable when not needed. Adjusting element controls position of the packing halves. Hex cap on top of housing unscrews to remove rubbers; an adapter on bottom is used for fitting to different sizes of connections. *Equipment Engineers, Inc., Dallas, Tex.*



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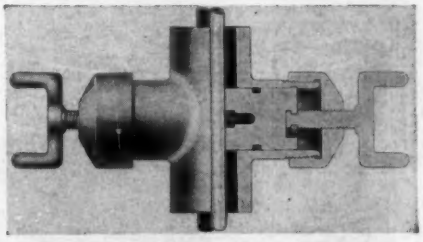
(4) BLOWOUT AND FLOW PREVENTER stops pressure surges and "heading" when pulling rods from wells which may have tendency to flow intermittently. This preventive or "safeguard" item for well-servicing equipment furnishes cheap but positive protection against potentially dangerous and messy situations. Similar in design to the



The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

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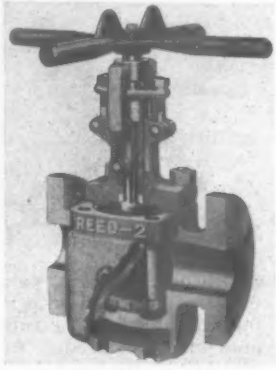
OIL AND GAS EQUIPMENT Digest

IT'S NEW ✓ CHECK IT

above rod stripper, cylindrical steel rams are used to which a fabric-reinforced synthetic rubber is molded—preventing leakage when exposed to as much as 4,000 p.s.i. pressure differential. Top of the blowout preventer is fitted with 3-in. male thread to screw into bottom of the stripper housing, when the two units are used together. *Equipment Engineers, Inc., Dallas, Tex.*

IT'S NEW ✓ CHECK IT

(5) JACKETED STEEL VALVE is designed to permit opening or closing regardless of cold conditions which may form hydrates in gas flow, or tend to harden and congeal such materials as tars, waxes, sulfur, asphalt, petroleum residues, molten caustic. These substances must be kept fluid for transmission through lines and fittings. Expansion and contraction do not affect action of the valve disks, which are accurately guided by the disk holder yet are free to float as to the holder and body seat. *Reed Roller Bit Co., Houston, Tex.*



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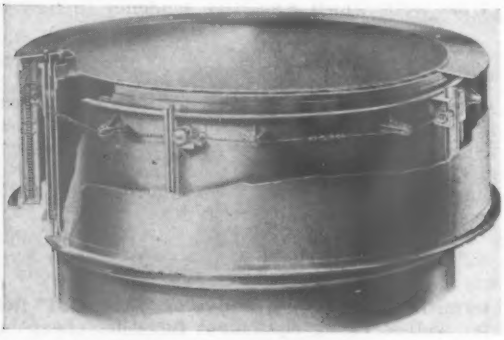
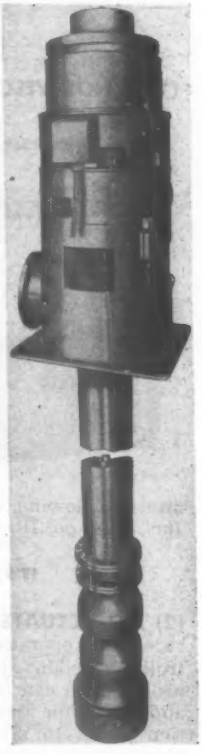
(6) VAPOR LIFT TANK ROOF provides variable vapor space of ample capacity to permit expansion or contraction, eliminating storage losses from breathing. A single "Vapor-Lift" roof tank can be installed with excess vapor capacity to accommodate the breathing of several cone roof tanks. Stabilizers keep the roof level at all positions regardless of lateral winds or unbalanced snow loads. The dip ring, an integral part of the roof, rides in the liquid seal chamber which is filled with sealing oil of special character. Weather skirt forms a canopy to protect the liquid seal and stabilizers. Outer rim of roof incorporates non-flexing girders. *Hammond Iron Works, Warren, Pa.*



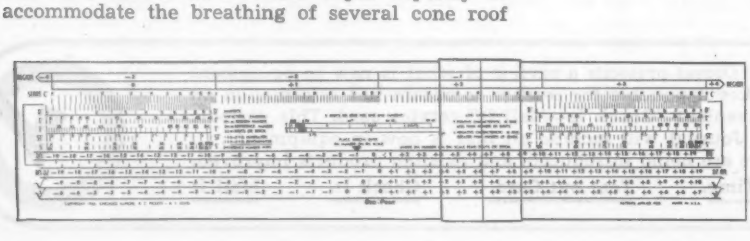
IT'S NEW ✓ CHECK IT

(7) VERTICAL TURBINE PUMP now is being manufactured in units so that a given size can cover a wide range of head by simply varying the number of stages. Applications include water supply, pumping gasoline from underground storage, dewatering sumps, circulating water for cooling towers, refinery installations. Pump is arranged for electrical motor drive, belt drive, or right angle drive. Motor driven units can be furnished with automatic solenoid-operated oilers. To accommodate lowering liquid levels, height of column may be increased by removing discharge head and driver only. Capacities: 50 to 15,000 g.p.m. Discharge pressures: to 250 lb. above surface with temperatures to 200° F. *Pacific Pumps, Inc., Huntington Beach, Calif.*

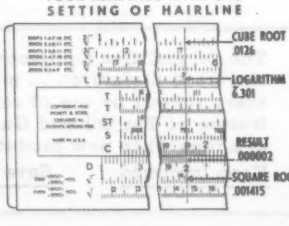


IT'S NEW ✓ CHECK IT

(8) A SLIDE DECIMAL POINT LOCATOR and a new slide rule are combined together. Placing the decimal point is one of the stumbling blocks in slide rule use. The Deci-point does this with simple mechanical accuracy for up to 19 places in involved expressions. Thus slide-rule calculations are so simplified that even those with limited mathematical background can evaluate and point off relatively complicated terms. In addition, 30-in. scale accuracy is obtained for cube root, 20-in. accuracy for square root, and with one setting of the hairline can be read: Result, square root, cube root, and logarithm. Also, with one setting are determined the digits or zeros in the result, square root and cube root. *Pickett and Eckel, Chicago, Ill.*



FOUR READINGS WITH ONE SETTING OF HAIRLINE



TRADE LITERATURE

OIL AND GAS EQUIPMENT

(9) HAND TOOLS FOR OIL INDUSTRY. A profusely illustrated 116-page catalog presenting the entire line of "Plomb Streamlined Tools," including a wide variety of wrenches, sockets, hack saws, files, pliers, hammers, punches, tool chests, roller cabinets, and other implements. *Plomb Tool Co.*

IT'S NEW CHECK IT

(10) PARAFFIN SOLVENT a booklet describing Klenzoyl, a product used in the oil industry for removing paraffin from wells, tank bottoms and pipe lines. It is also claimed the product will keep paraffin from reforming for the life of the well, if a cup a day is used after once used to remove initial paraffin deposits from the well. A solvent; not an acid. It is fire-proof; contains no lye. *Klenzoyl Distributing Co.*

IT'S NEW CHECK IT

(11) SPECIFICATION CHART FOR ELECTRODES. A handy chart giving following data on stainless steel and ferritic alloy welding electrodes: Weld metal chemical composition of 42 Arcos electrodes; heat-treatment specifications of the welded structure for the more important stainless and alloy grades; and identifying grade information. *Arcos Corp.*

IT'S NEW CHECK IT

(12) TECHNICAL LABORATORY APPARATUS. A publication containing details and illustrations of the latest apparatus developed for industrial laboratories. High vacuum pumps, constant temperature ovens, oscilloscopes, Photelometers, and infrared spectrophotometers, are among the many new and improved instruments described. *Central Scientific Co.*

IT'S NEW CHECK IT

(13) DYNAMITE COUPLINGS. A well-illustrated and informative booklet on "Spiralok," a rigid casing for joining dynamite cartridges used in seismograph work, blasting for pipe lines, etc. Easy to assemble and take apart; protection for the charge; permits joining cartridges of explosives to make a rigid column of any reasonable length; impossible for dirt or sand to get between cartridges and reduce the effectiveness of the shot. *Hercules Powder Co.*

IT'S NEW CHECK IT

(14) SPECIALIZED DRILLING TOOLS. A new and complete catalog of cutting, fishing, sidewall coring, directional drilling, and other specialized tools. Illustrated in three colors, it contains a pictorial index on the tools; presents a brief informative "Facts About Cutting and Fishing" article; and describes the operation of the tools. *Houston Oil Field Material Co., Inc.*

IT'S NEW CHECK IT

(15) DEEPWELL WATER PUMP. A new brochure illustrating and describing latest developments in this field. Printed in three colors, cutaway sketches are employed to show three deepwell pumps types having more than 100 impeller designs, each with different hydraulic characteristics. *Byron Jackson Co.*

IT'S NEW CHECK IT

(16) STEAM TRAPS. A catalog and educational handbook on condensate drainage. Quite complete, including cutaway drawings, physical data, and trapping layouts for modern applications. Deals with all regular and special types of steam-trap installations. *Armstrong Machine Works.*

IT'S NEW CHECK IT

(17) V-BELT DRIVE CATALOG, with all required information to make correct drive selections reduced to handy charts, tables and drawings. New "Magic-Grip" sheave is described. The "Econograph" method of drive selections is illustrated. Additional data given on Vari-pitch sheaves and drives, and on the Vari-pitch speed-changer. *Allis-Chalmers Mfg. Co.*

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(18) GAS-WELDING AND FLAME-CUTTING APPARATUS. A very elaborate 104-page catalog covering all phases of the subject, with pictorial and engineering data supporting the proper use and application of gages, torches, nozzles, cutting tips, and other accessories for flame cutting and gas welding. *Victor Equipment Co.*

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(19) FLEXIBLE COUPLINGS for hot-oil pump drives and other service where peak efficiency is required. A well-engineered catalog is available describing flexible couplings designed to provide angular and parallel misalignment, as well as free end float. Backlash, friction, wear and cross pull are said to be eliminated. No lubrication is required. *Thomas Flexible Coupling Co.*

IT'S NEW CHECK IT

(20) PUMP VALVES. A new catalog describing the Royal Crown pump valves, termed "a pump valve with 1,000 seats." Each turn or swing of the valve produces a new perfect seat. Offered in 8 standard metal combinations and 15 factory stock valve sizes. *Madsen Iron Works.*

IT'S NEW CHECK IT

(21) PROTECTION FOR GASOLINE MOTORS by adding Lubri-Gas, a cleansing and lubricating medium, to ordinary gasolines. Provides lubrication for the upper cylinder walls of a gasoline engine without producing carbon, foul spark plugs, pitted valves, or faulty ignition. More mileage and more power are offered. Catalog and details available. *Lubri-Gas Laboratories.*

IT'S NEW CHECK IT

W. H. JACKSON *C. O. KLEINSMITH* *H. F. SCHLITTER*

A. B. (Abe) Haglund, formerly vice president in charge of lathe sales for Axelson Manufacturing Co., Los Angeles, Calif., has resigned, following a service of 33 years. He has become affiliated with Griffin & Ross Machinery Co., Los Angeles representative for Axelson lathes. **W. H. (Jack) Jackson,** also a veteran of the company, succeeds Haglund as chief of foreign and domestic lathe sales.

C. O. Kleinsmith has been elected a vice president of National Carbon Co., a unit of Union Carbide & Carbon Corp. Kleinsmith was formerly general sales manager for the company's "Eveready" products. Kleinsmith announced the appointment of **D. B. Joy** as general sales manager for carbon products, and **R. P. Bergan** as general sales manager for the company's consumer and related products.

Organization of Falcon Products, Inc., manufacturers of slush-pump repair parts, is announced by **Jack Pike,** president. General manager of the company is **H. F. Schlitter,** who is also vice president. Secretary-treasurer is **Hugh Kirkwood.** Products of the company are being marketed under the name "Falcon", and are distributed exclusively through supply stores.

JOHN R. MUNN *A. E. HECKER* *F. W. PARKER, JR.*

John R. Munn, a director of Elastic Stop Nut Corp. of America since 1927, has been chosen president of the company to fill the unexpired term of the late William T. Hedlund.

Arthur E. Hecker, formerly vice president and general manager of Chemical Construction Corp., has been elected president to succeed the late W. S. Stowell. **Blakeslee Burnes,** a vice president of the company, has assumed the additional duties of general manager. **R. E. Papean** and **S. F. Spangler** have been elected vice presidents.

Fred W. Parker, Jr., has been named directing head of a new field operations program developed by The Timken-Detroit Axle Co. in order to extend the scope of its service to users in the field. **O. E. Johnson** will handle duties of field sales manager, and **Daniel Celluci** those of field service supervisor. **K. P. Hayes** continues as assistant service manager, and **J. L. Kermath** will serve as parts sales manager.

Newly elected officers of the New York Chapter of Nomads, pictured in the accompanying cut, are: Back row— **C. R. Tunnell,** International General Electric Co., treasurer; **E. L. Carter,** export representative, assistant treasurer; **W. H. Siems,** Hughes Tool Co., regent; **H. J. McAdams,** Jones & Laughlin Steel Co., sergeant at arms; **G. V. Leece,** Gardner-Denver Co., assistant sergeant at arms, and **J. W. Reed,** Cooper-Bessemer Corp., assistant secretary. Front row—**R. M. Dinges,** PAW, secretary; **E. H. Trammel,** Mission Manufacturing Co., president, and **W. G. Foster,** Anglo-American Purchasing Co., vice president. **W. J. Campbell,** elected regent, is not in the photograph.

G. A. Tompson, vice president, Bethlehem Supply Co., announces appointment of **W. M. Sanders,** Tulsa, as Veterans' Counselor. Sanders, presently manager of the industrial and public relations department for Bethlehem Supply and for American Well & Prospecting Co., Corsicana, Tex., both Bethlehem Steel Co. subsidiaries, will work under the recently adopted Bethlehem Steel Procedure for Employment of Veterans of World War 2. In the picture at right, Sanders is seen interviewing **Lloyd E. Simpson,** war veteran seeking employment with the supply company, explaining the advantages accruing to him under the new procedure. The program aims to give attention to each individual's problems. Special counselors and staff for this work are being provided in each personnel office.

For a number of months the various operations of Bethelhem Steel have been employing returned veterans. By end of November, over 16,000 had been hired. At Bethlehem Supply Co.'s plant in Tulsa, 90 discharged veterans have either been reemployed or newly hired, employment records show.

The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

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REFINING

Ashland to Operate Plant Bought From Texaco

ASHLAND, Ky.—Paul G. Blazer, chairman of Ashland Oil & Refining Co., which recently purchased properties of The Texas Co. in eastern Kentucky, including the refinery at Pryse, says Ashland plans to operate the refinery for the present as near to its 5,000-bbl. daily capacity as crude-oil supply and refinery allowable will permit. Besides the Pryse plant the transaction includes 412 stripper wells and 75 miles of gathering lines in Lee, Estill and Powell counties.

Special Fuel Drives New Jet-Propelled Aircraft

NEW YORK.—The Texas Co. has announced that it is manufacturing special fuels and lubricants for jet-propelled fighter aircraft. The fuel was described as "somewhere between kerosene and gasoline in nature," and the lubricants as able to withstand temperatures ranging from 80° to 90° below zero to 250° above.

Refinery Promotions Made By New Jersey Standard

NEW YORK.—Donald L. Ferguson, general superintendent of the Bayway, N. J., refinery, has been appointed assistant manager of New Jersey refineries of Standard Oil Co. of New Jersey in a series of organization changes at the Bayway and Bayonne plants. Richard J. Kaul, assistant to the general manager of East Coast manufacturing operations, succeeds Ferguson at Bayway.

D. L. FERGUSON

J. Raymond Eiffe has been appointed assistant general superintendent and process superintendent at Bayway and Bryant F. Kenney transferred to the New York offices as assistant to the general manager of East Coast operations.

Willard F. Wadt has been appointed acting process assistant to the manager of the New Jersey works, and Charles E. Borgstrand has been made acting process superintendent at Bayonne; Francis J. Powers, assistant process superintendent at Bayonne, assumes additional responsibility as head of process control.

Ferguson joined Standard of New Jersey in 1920 following graduation from Purdue University. After 6 years in the development department, now Standard Oil Development Co., at Bayway, he was made assistant superintendent of the Everett, Mass., refinery of Colonial Beacon Oil Co., New England affiliate of Standard Oil Co. (N. J.), subsequently becoming general superintendent, and later manager and a director of Colonial Beacon. He spent more than 3 years in France as manager of the Port Jerome refinery of Standard-Francaise des Petroles, a Jersey Standard affiliate, returning to the Bayway refinery as assistant general superintendent in 1938. He was made general superintendent at Bayway in 1940.

Kaul joined the company as a student engineer after graduation from Stevens Institute of Technology in 1923. He served 9 years as superintendent of the chemical products plant and in 1943 was made assistant to the New Jersey Works manager. Promotions followed, and last year he assumed the additional duties of secretary to the manufacturing committee.

Bill Would Give "Royalty Oil" to Small Refiners

WASHINGTON.—Refineries which lack their own sources of crude-oil supply could buy "royalty oil" from the Government under provisions of a bill introduced by Sen. Joseph C. O'Mahoney, Wyoming. "Royalty oil" is oil received by the Government from private wells drilled on the public domain.

"The whole philosophy of the general leasing act," O'Mahoney said, "was to encourage small independent enterprise, and the new bill would have the effect of giving the small refineries an opportunity to secure their crude-oil supplies from the government royalty oil."

The bill would authorize sale of the oil at not less than the market price. Sales would be handled by the secretary of the interior. The Interior Department now sells the royalty oil to the highest bidder.

Suits Allege Violations of Refinery Market Rules

CHICAGO. — Violations of price regulations in the sale of oil products in the refinery market are alleged in suits filed by Office of Price Administration against five oil companies in the Chicago and Twin Cities districts. These actions, all similar in nature and filed in federal district courts, grow out of the current petroleum-price survey conducted by OPA. It was said more suits are to be entered.

Improper pricing programs and lack of proper record maintenance are named as grounds for the suits. OPA officials conceded that the cases were based on transactions with relatively few customers and involving only a minor part of the defendants' business.

The prosecutions seek injunctions designed to require that the companies apply for approval of prices by OPA's petroleum price branch in Washington on certain products which heretofore are alleged to have been sold without obtaining such approval.

All the complaints ask that the court direct the companies to account for alleged overcharges and include claims for judgment in amount of three times the alleged overcharges.

OPA officials said they sought a court order so that investigators could proceed without delay. It was asserted that minor parts of a firm's business were taken for checking because of the vast amount of time required to check a large organization completely.

The suits allege that defendants have not obtained on the specific transactions involved ceiling prices within 15 days of sale and have failed to keep available for inspection the basis on which prices were established.

Peacetime Expansion Plans Announced by Pure Oil

CHICAGO.—Refinery construction plans of Pure Oil Co., announced by Henry M. Dawes, president, and waiting on availability of materials through the advent of peace, include a comprehensive modern plant for manufacturing lubricating oils and greases from oil reserves which have unusual qualities for such purposes. A carbon disulfide plant will be built to increase both in volume and variety the chemicals recoverable from refinery byproduct gases. Another project calls for a new research laboratory.

In a letter to shareholders, accompanying the annual report of the company, Dawes emphasized the danger to the American spirit of enterprise if detailed regimentation which has handicapped the oil industry should be continued indefinitely. "Free play of ordinary human incentives has been largely suspended," he said, "a condition which will result in an irreparable injury if continued when the war emergency is over. In spite of this, it is to the everlasting credit of the industry that it has carried on with courage and patriotism in the performance of its vital function."

Scientific and technical strides in the oil industry, under the impetus of war, will greatly benefit American motorists and the nation's economic structure when peace comes, Dawes said.

Output of Shale Oil to Be Increased in Australia

WASHINGTON. — Expanded facilities at the Glen Davis oil-shale project in New South Wales, Australia, are expected to increase the current year's production to about 250,000 bbl. compared with 100,000 bbl. in 1944, according to trade reports reaching the Department of Commerce. Glen Davis shale is considered by many authorities the richest oil-bearing shale in the world. Increased utilization will be of great importance in meeting Australia's petroleum requirements.

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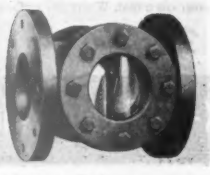
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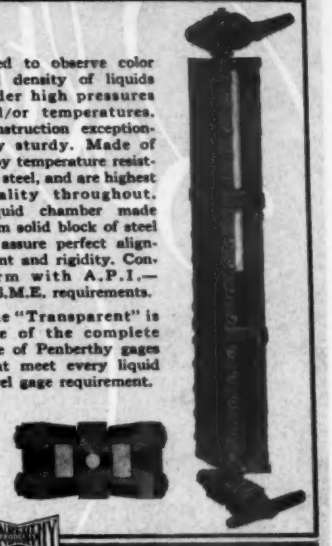
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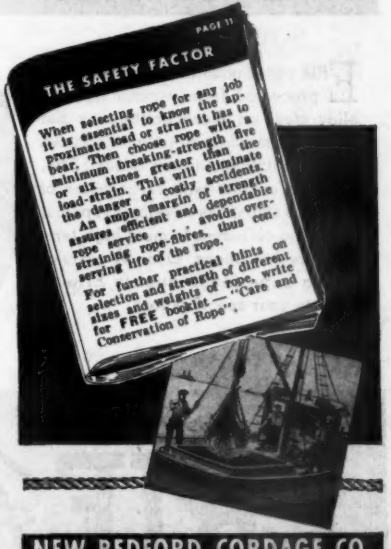
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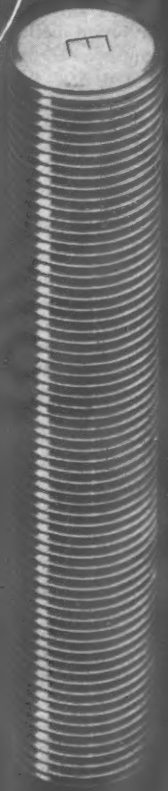

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Natural Gas

Guymon Sector of Hugoton Field Attains New Peak

OKLAHOMA CITY.—Production in the Guymon (Oklahoma) sector of the three-state Hugoton gas field, scored a new high in 1944, leaping to 43,290,965,000 cu. ft. from the 10,374,054,000 recorded in 1943, a gain of 318 per cent. Cities Service Gas Co. produced 26,005,295,000 cu. ft.; Republic Natural Gas Co. 10,947,553,000; Cabot Carbon Co., 5,199,508,000; Southwest Public Service Co., 865,982,000; Phillips Petroleum Co., 17,627,000.

The Kansas sector's output rose 30 per cent from 63,353,908,000 cu. ft. to 84,007,568,000. Figures for the Texas Panhandle portion of the field were not available.

Floor for Natural-Gas Price Is Proposed in Kansas

TOPEKA.—Natural gas could not be sold for less than 6 cents per 1,000 cu. ft. in Kansas under the provisions of a bill introduced in the House of Representatives by the oil and gas committee. Violation would be a misdemeanor punishable by a fine of $500 to $25,000.

Rep. Vern R. Mayo of Garden City said the measure was intended to halt wasteful use of gas in the big Hugoton field.

Some Hugoton gas has been sold as low as 3 or 4 cents per 1,000 cu. ft., he reported, although its actual value is around 8 to 10 cents.

Coffman Becomes Chief of FPC Rates and Research

WASHINGTON.—The Federal Power Commission has appointed Edgar S. Coffman chief of the division of rates and research, succeeding Hanina Zinder.

E. S. COFFMAN

Coffman was with the commission for 11 years from 1933 to 1944 in various capacities, his most recent position being that of principal rate investigator. He comes to the FPC from the Reconstruction Finance Corp., where he has been electric power and gas consultant and served as assistant power procurement officer for Defense Plant Corp., Rubber Reserve Co., and Defense Supplies Corp.

Prior to entering the federal service, Coffman was with the Power Authority of New York and spent 6 years as staff engineer with the Indiana Public Service Commission.

Senate Committee Studying Carbon-Black Shortage

WASHINGTON.—A shortage of carbon black currently appears to be chief stumbling block in the way of increased production of tires and other rubber goods, and the Senate war investigating committee is making a staff inquiry into the situation.

As explained by officials of War Production Board, expansion of facilities for producing carbon black has failed to keep pace with either the scheduled or the actual increase in tire output during recent months, with the result that production of tires, camelback, and other rubber goods has had to be cut back. Carbon-black producers are being asked to increase their output if possible, but it is probable construction of additional facilities will be authorized.

The tire industry was freed last week from its pledge of 7-day-a-week operation, because its soaring production has outrun the supply of carbon black.

WPB and the War Department jointly announced that plants and workers could return to the 6-day week for the remainder of this month.

In achieving what WPB called a "truly remarkable" 46 per cent industry-wide increase in heavy tire output since October, some plants have outstripped their supply of tire cord as well as carbon black. Production leaped from 1,217,000 in October to 1,700,000 heavy tires in January.

Commission Head to Fight Exportation of Texas Gas

AUSTIN.—Olin Culberson, chairman of the Texas Railroad Commission, has announced that he will fight the application of Metropolitan Eastern Corp. for authorization to build an 18-in. pipe line designed to move 140,000,000 cu. ft. of natural gas daily from East Texas fields to Ohio. Culberson said he would protest against such authorization by Federal Power Commission whether other members of the Texas Railroad Commission joined him or not. Noting that the application is made in the name of the war effort, he said:

"I wonder how many lines from Texas they are going to need. I wonder how long people who seem intent upon plundering our resources are going to use the war and the most unusual winter weather conditions in history to justify their actions.

"We have tremendous gas reserves, but some time they are going to be exhausted. Meantime, we are building our whole economy on gas and oil. When these are taken away, you hasten the day when we shall have to turn to some other economy.

"If there is ever a time these resources need legislative protection, it is now."

Natural Gasoline

Sinclair Affiliate to Build Combination in Venezuela

NEW YORK.—Venezuela Petroleum Co. has received from Petroleum Administration for War and War Production Board authorization to construct a combined casinghead-gasoline-recovery and maintenance-of-pressure plant on the concession of the company's operating subsidiary in the state of Monagas. Venezuela. About 85 per cent of Venezuela Petroleum's stock is owned by Sinclair Oil Corp.

The project is designed to recover the natural gasoline and liquefied petroleum gases from natural gas now being produced and burned. Material is being ordered and it is expected the plant will be in operation this year. Liquefied products will be recovered, and the dry gas compressed and returned to the oil-producing formation to maintain pressure, thereby greatly increasing ultimate production. It is estimated that the cost will be in excess of $2,500,000.

N.G.A.A. Annual Meeting Postponed Indefinitely

Directors of Natural Gasoline Association of America have voted to postpone indefinitely the twenty-fourth annual convention originally scheduled for April 11-13, in Dallas. A special meeting of the directors will be held to transact necessary business and to consider matters of policy which may affect the industry throughout the year.

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PIPE LINES

Metropolitan Company Files Pipe Line Plan

WASHINGTON.—Application has been filed with Federal Power Commission by Metropolitan Eastern Corp. for a certificate of public convenience and necessity to construct and operate 825 miles of 18-in. natural-gas pipe line extending from the East Texas gas fields to Ohio. The project would include five compressor stations totaling 25,600 hp. and have an initial daily capacity of 140,000,000 cu. ft. of gas. Total cost is estimated at $23,500,000.

The applicant is a new corporation, organized under the laws of Delaware and with principal offices in Wilmington, Delaware, and a New York branch office at 50 Church Street. The company was organized, the application says, with the present sole intent to construct and operate this particular line. It is proposed to start construction during April 1945 and complete it on or before October 31 this year.

It is planned, the application adds, to finance the project by 3 per cent first mortgage bonds for about 70 to 75 per cent of the total amount required, and to procure the balance by common stock issue.

FPC Schedules Hearings On Two Gas Pipe Lines

WASHINGTON.—The Federal Power Commission will hold a hearing on March 21 in Washington on an application filed by Tennessee Gas and Transmission Co., Houston, for a certificate of public convenience and necessity to construct and operate additional facilities including 95 miles of 16-in. pipe line from San Salvador field in Texas to connect with the company's present main line, and to operate under lease from Defense Plant Corp. four additional compressor stations. The facilities would increase the Tennessee company's system delivery capacity by about 60,000,000 cu. ft. per day and are necessary, according to the application, to permit greater deliveries of natural gas into the Appalachian area for essential war production.

Also announced last week is the commission's order setting hearing for March 26 in Washington on an application filed by United Gas Pipe Line Co., Shreveport, for authorization to construct and operate additional facilities including 142 miles of 24-in. pipe line from the Carthage field in Texas to connect with both Tennessee Gas and Transmission's and United's facilities in Ouachita Parish, Louisiana.

In detail Tennessee Gas and Transmission proposes (1) to construct and operate about 95 miles of 16-in. pipe line extending from the San Salvador field in Hidalgo County, Texas, in a general northeasterly direction to a point of connection with the southern terminus of the company's main Texas to West Virginia line in Nueces County, Texas, and a dehydration plant to be operated in conjunction with the line, and (2) to operate, under a proposed lease agreement with four additional compressor stations of 8,000 hp. each to be located in Washington County, Mississippi, Hardeman and Robertson Counties, Tennessee, and Montgomery County, Kentucky. According to the application estimated cost of the pipe line and dehydration plant is $2,552,600 and of the compressor stations $5,120,000, or a total of $7,672,600.

The proposed United Gas Pipe Line project includes (1) about 142 miles of 24-in. pipe line extending from the company's gasoline plant in the Carthage field, near Carthage, Panola County, Texas, to connect with existing facilities of Tennessee Gas and Transmission and of the applicant in the Monroe field, Ouachita Parish, Louisiana, and (2) four measuring stations, a telephone line and appurtenant facilities. Estimated total cost, according to the application, is $7,090,000, all of which United proposes to finance out of cash on hand.

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Panhandle Eastern Attaches Parish Interests

Panhandle Eastern Pipe Line Co. has attached large interests of Frank P. Parish of Taneytown, Md., former president of the company, while filing a civil action designed to recover $281,895 for alleged breach of duty.

The Panhandle Eastern company's petition filed in federal District Court, charged that the irregularities it alleged, began in 1930 while Parish was president of the company, member of its board of directors and a holder of more than a majority of its outstanding stock.

It said the actual amount it sought to recover was $208,715, plus interest at 6 per cent. The company moved to attach interests of Parish in five southwestern Kansas oil wells, gathering lines and other equipment.

The case probably will be heard during a September term of court.

Dow Resigns as Director of ODT Liquid Transport

WASHINGTON.—Fayette B. Dow has resigned as director of the Liquid Transport Department, Office of Defense Transportation, owing to press of other duties, after giving 3 years of service to ODT. Before assuming that post he had been for more than a year consultant to Ralph Budd, transportation commissioner of the advisory commission to Council of National Defense. He is general counsel for National Petroleum Association.

Mississippi Governor Reviews Pipe-Line Plan

JACKSON, Miss.—Representatives of the Interstate Oil Pipe Line Co. and Standard Oil Co. met in closed session with Gov. Thomas I. Bailey and members of the state Oil and Gas Board here last week.

"It was an informal session to discuss their plans for proposed construction of a pipe-line system from Mississippi fields to Louisiana for refinement," Governor Bailey said. "We reached no decisions and no action was taken."

The oil men said they had "no statement" for the press. They were P. H. Hunter, L. F. Kahle, M. W. Boyer and S. W. Day, representing Interstate, and Cecil Morgan, representing Standard Oil Co. of New Jersey.

Plans for a pipe line from Mississippi to Louisiana were announced several weeks ago by the Interstate company. At that time, the governor said he would fight the pipeline proposal, seeking to force construction of additional refining capacity in Mississippi.

February Output of Ships Includes 24 Tankers

WASHINGTON. — Among 125 ships built in merchant shipyards during February were 24 tankers, including 4 of naval type. This compares with 22 tankers delivered into service during January.

Contributing five tankers each in February were Alabama Dry Dock & Shipbuilding Co., Mobile; Kaiser Co., Inc., Swan Island Yard, Portland, Ore.; Marinship Corp., Sausalito, Calif., and Sun Shipbuilding & Dry Dock Co., Chester, Pa. Others contributing were East Coast Shipyards, Inc., Bayonne, N. J., two; Bethlehem-Sparrows Point Shipyard, Inc., Sparrows Point, Md., and Welding Shipyards, Inc., Norfolk, Va., one each.

Wyoming Price Posted

Sinclair-Wyoming Oil Co. has established posted prices for Sundance crude in the Bailey Dome field in Carbon County, Wyoming, as follows: Below 29 gravity, 96 cents; 29-29.9, 38 cents, with 2 cents added for each degree up to and including 40 gravity and over, at $1.20. The prices were made effective on January 23, 1945.

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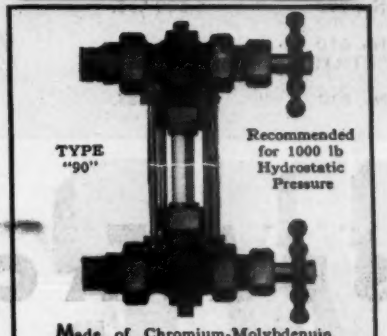

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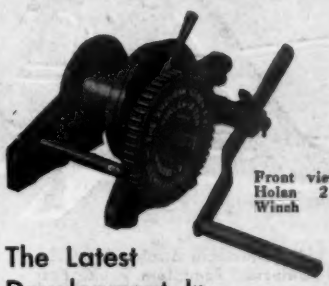

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No. 405	Capacity 2,000 LBS.	No. 710	Capacity 10,000 LBS.
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No. 408	" 4,500 LBS.	No. 915 (Illustrated)	" 16,000 LBS.
No. 509	" 6,500 LBS.		
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Type "A" Adjustable Stroke Post	8,000 LBS.
6" x 5" Universal Pendulum Stroke Post	10,000 LBS.
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Clamp Type Pendulum Multiplier or S.P.	12,000 LBS.
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Type "M" Adjustable Stroke Post	14,000 LBS.
No. 915-W, 915-TOW and 920-TOW Counter Balanced Stroke Post (Illustrated)	26,000 LBS.

BELL CRANK used in sucker-rod applications for pumping one or more wells off pumping unit or gear box.

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SWINGS

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Type "S" Swings, regular and adjustable		5,000 LBS.
Type "RS-HS-EHS" Swings	"RS"	6,000 LBS.
	"HS"	8,000 LBS.
	"EHS"	10,000 LBS.
Regular Link Type Swing		16,000 LBS.
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"TO" Link Type Swing		20,000 LBS.
180 Degree Trussed Swing	6 in.	8,000 LBS.
	8 in.	20,000 LBS.
180 Degree Swing with Center Reinforcing Plate	10 in.	10,000 LBS.
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Exploration and Drilling

Week's Highlights

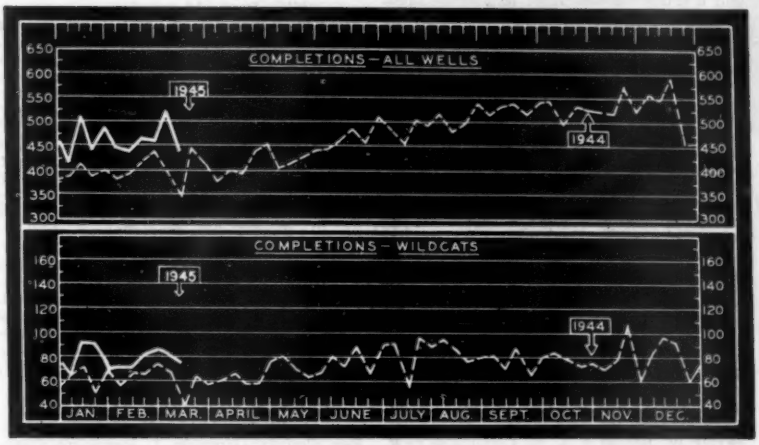
MISSISSIPPI added two more new pools to its growing list last week, with the completion of discovery wells in the Hub field of Marion County, and the Soso field in southwestern Jasper County. Both of the new fields produce condensate. Both discoveries found only salt water in the Massive sand, but backed up and made producers in shallower formations.

The Hub field, opened by Humble Oil & Refining Co. 1 Evans, NW NE 15-2n-18w, Marion County, is only about 11 miles northwest of the Baxterville field opened last November by the Gulf Refining Co. The Evans well is producing from the second sand stringer above the true Massive sand, and has been completed for 72 bbl. daily of dark colored 52-gravity condensate, with gas-oil ratio of 14,750 to 1, through 5/32-in. choke on 2-in. tubing. Tubing pressure is 3,000 lb., from perforations at 9,127-29 ft.

The Soso field, opened by Gulf Refining Co. 1 Edwards-Bailey unit, NW SE 27-10n-13w, Jasper County, is producing from the Xmas sand zone in the basal Eutaw. On a 24-hour test, this well flowed 65 bbl. of 67-gravity condensate through ⅜-in. tubing choke; gas-oil ratio 32,150 to 1; tubing pressure 2,490 lb.; bottom-hole flowing pressure 2,953 lb., from perforations at 6,590-6,600 ft. Choke was reduced to ¼-in. and flow was 98 bbl.; gas-oil ratio 31,700 to 1; tubing pressure 2,500 lb.; bottom-hole flowing pressure 2,946 lb.

The Hub field is probably on another salt dome. Its performance in the Massive is somewhat disappointing, but further tests are indicated. This testing will be encouraged by the apparent bright prospects indicated by extension wells now drilling in the nearby Baxterville field.

The Soso discovery lies directly in line along the west-east trend of recent discoveries from Cranfield to Mallalieu, to Gwinville, to Heidelberg and Eucutta, to Langsdale. However, Soso is reported to be on a gravity maximum, whereas all the other fields along this trend are supposed to be on gravity minimums, reflecting deep-seated salt domes.



Solid line charts current weekly completions, service wells in Eastern area included

COMPLETIONS IN ALL FIELDS . . .

Week ended March 10, 1945

	Oil	Gas	Dry	Total	Footage	Total Comp. to date 1945	1944
N. Y., Penna., W. Va.	41	13	*39	93	153,862	980	615
Ohio	1	9	5	15	39,208	134	176
Indiana	0	0	1	1	717	36	47
Kentucky	2	3	1	6	13,894	74	110
Illinois	10	0	9	19	53,140	324	322
Michigan	4	1	11	16	37,387	135	101
Kansas	12	2	14	28	91,031	276	333
Nebraska, Missouri, Iowa	1	0	0	1	255	10	11
Oklahoma	25	1	19	45	238,771	454	274
Texas:							
North Central	12	2	17	31	78,647	380	229
West	20	0	6	26	129,807	341	274
Panhandle	2	12	1	15	50,238	105	24
Eastern	2	6	1	9	61,214	57	60
Gulf Coast	20	3	6	29	209,168	304	90
Southwest	5	1	6	12	59,444	125	187
Total Texas	61	24	37	122	588,518	1,312	864
Louisiana:							
Northern	2	0	2	4	15,575	53	45
Southern	6	1	6	13	119,654	114	71
Total Louisiana	8	1	8	17	135,229	167	116
Arkansas	0	0	0	0	0	26	40
Mississippi	2	0	5	7	50,033	62	27
Southeastern States	0	0	0	0	0	4	†
Montana	5	0	1	6	14,970	57	38
Wyoming	0	0	1	1	5,366	41	21
Colorado-Utah	1	0	0	1	6,974	7	7
New Mexico	7	0	2	9	32,585	96	79
California	38	2	8	48	190,531	439	329
Total United States	218	56	161	435	1,852,471	4,634	3,511
Total previous week	308	45	169	522			
Total March 11, 1944	186	36	88	310			

*Includes 36 service wells. †Included in total shown for Mississippi.

SOUTHWEST TEXAS

Six Discoveries Made In Southwest Texas

CORPUS CHRISTI.—James Stewart & Co., Inc. 1 Mrs. Grace Gaffney, discovery well of the Gaffney field, Victoria County, 3 miles southeast of Terrell field and 6 miles northwest of McFaddin field, on 24-hour potential test, flowed 49.50 bbl. of 27°-gravity oil through 4/32-in. choke, no water, gas-oil ratio 119, from 30 perforations at 5,017-21 ft. Total depth is 5,980 ft., with 5½-in. casing at 5,112 ft.

The Texas Co. 1 McGill Brothers, new discovery, 13 miles southwest of Encino, in Brooks County, flowed 276 bbl. of 40.1°-gravity oil through 5/32-in. choke, no water, tubing pressure 1,000 lb., casing sealed, gas-oil ratio 857, from 18 perforations at 6,114-17 ft., on 24-hour potential test. Total depth is 6,795 ft., with 5½-in. casing at 6,546 ft.

J. W. Gorman & McDermott 2 J. F. Welder, new discovery, 6 miles northeast of Freer in Duval County, in Section 211, on 24-hour potential test, flowed 107 bbl., no water, through ¼-in. choke, tubing pressure 40 lb., casing pressure 540 lb., gravity 24°, gas-oil ratio 200, from 48 perforations at 2,470-80 ft., total depth 2,512 ft., with 5½-in. casing at 2,502 ft. The name "Gormac" was turned in by the operators for this field.

Fred W. Shield 1 J. L. Courtney, new discovery at Tulsita, Bee County, on 24-hour test, flowed 380 bbl. through 3/16-in. choke, no water, gravity 34.1°, tubing pressure 760 lb., casing pressure 1,380 lb., gas-oil ratio 571, from 36 perforations in sand at 7,048-59 ft., total depth 7,504 ft., with 5½-in. casing set at 6,727 ft. The name "West Tulsita-Wilcox" is being reported by the operators for this field.

Sun Oil Co. 1 R. A. Thompson, wildcat, 5 miles southwest of Goliad, in Goliad County, a new discovery called "West Goliad field" by the operator, cemented 4½-in. and 3-in. drill pipe at 11,161 ft. and flowed an estimated 140 bbl. daily of 44.1°-gravity oil and 8,200,000 cu. ft. gas through ¼-in. choke, from open hole at 11,161-181 ft.

Humble Oil & Refining Co. 1 Dan Sullivan, Account 1, wildcat, 8 miles southeast of Falfurrias, in Brooks County, on 16-hour test flowed at rate of 297 bbl. daily through ½-in. choke, tubing pressure 1,800 lb., gas-oil ratio 998, gravity 40.7°, from perforations at 8,537-43 ft., total depth 8,545 ft., 5½-in. casing set on bottom.

SUCCESSFUL WILDCAT COMPLETIONS IN SOUTHWEST TEXAS

Brooks County: New discovery. Texas 1 McGill Bros., 13 mi. SW of Encino in San Antonio-J. A. and A. M. Garcia Survey, TD 6,795 ft., perf. 6,114-17 ft., PT 276 bbl. daily through 5/32-in. choke, gas-oil ratio 857, tubing pressure, 1,000 lb., gravity 40.1°, no water.

Duval County: Gormac pool discovery. J. W. Gorman & McDermott 2 J. F. Welder, P. Poitevent Section 211, 6 mi. NE of Freer, TD 2,512 ft., perf. 2,470-80 ft., PT 107 bbl. daily, through ¼-in. choke, gas-oil ratio 200, tubing pressure 40 lb., casing pressure 540 lb., gravity 24°, no water.

Victoria County: Gaffney pool discovery. James Stewart & Co. 1 Mrs. Grace Gaffney, Juan Flores Survey, Abstract 29, 3 mi. SE of Terrell field, TD 5,980 ft., perf. 5,017-21 ft., PT 49.50 bbl. daily through 4/32-in. choke, gas-oil ratio 119, tubing pressure 700 lb., casing pressure 250 lb., gravity 27°, no water.

WILDCAT FAILURES COMPLETED IN SOUTHWEST TEXAS

Bee County: Humble 1 Josephine Chesnutt, 11 mi. NE of Papalote, in Miguel De Los Santos Grant, dry at 5,610 ft.

Duval County: M. E. Davis 3 Atlee Parr, San Andres Garcia Grant, 8 mi. SE of Benavides, dry at 7,532 ft.

Duval County: Argo Oil 1 Carrillo Heirs, AB&M Sur. 183, 10 mi. N of Benavides, dry at 4,950 ft.

Butcher-Arthur et al 1-A C. M. Robinson, AB&M Sur. 408, 6 mi. NW of San Diego, dry at 5,125 ft.

Hidalgo County: Kingwood Oil 1 John H. Shary, San Salvador del Tule Grant, 12 mi. NW of Edinburg, dry at 8,107 ft.

Texas 2 Argyle A. McAllen et al, Santa Anita "Manuel Gomez" Sur., 10.6 mi. NW of Linn, dry at 10,400 ft.

Jim Wells County: La Gloria Corp. 1 Geo. W. Reynolds, I&GN Sur. 141, 4 mi. W of Orange Grove, dry at 5,525 ft.

Nueces County: C. Andrade III 1 Rand Morgan, Sec. 411, Blk. 33, 8 mi. W of Corpus Christi, dry at 7,511 ft.

Refugio County: Hewit & Dougherty 2 K. D. Roche, Thos. O'Connor Sur., Blk. 59, dry at 6,800 ft.

DAILY AVERAGE PRODUCTION FOR WEEK

	Mar. 10 crude oil	Distillate, allied products	March PAW quota all oils	Mar. 3 crude oil
Alabama	250	.....	300	250
Arkansas	81,200	5,200	85,200	81,100
California	905,750	58,810	966,160	905,500
Colorado	11,000	.....	9,500	10,150
Eastern	61,550	8,400	76,600	61,000
Illinois	201,200	12,000	210,000	206,000
Indiana	12,300	.....	12,000	12,700
Kansas	251,450	4,300	278,300	244,400
Kentucky	27,200	3,200	35,200	29,700
Louisiana	366,300	40,000	400,000	364,600
North Louisiana	70,650	.....	.....	69,800
South Louisiana	295,650	.....	.....	294,800
Michigan	46,800	700	47,700	46,800
Mississippi	50,450	.....	53,000	53,400
Montana	23,300	300	23,300	23,300
Nebraska	900	.....	1,000	900
New Mexico	103,750	4,900	109,900	103,800
Oklahoma	369,200	28,000	391,000	368,600
Texas	2,159,000	156,000	2,316,000	2,152,500
East Texas	381,000	.....	.....	392,000
East Central Texas	146,700	.....	.....	150,300
North Central Texas	149,300	.....	.....	148,800
Texas Panhandle	88,000	.....	.....	88,000
West Texas	477,400	.....	.....	464,300
Southwest Texas	352,150	.....	.....	347,000
Texas Gulf Coast	564,450	.....	.....	562,100
Wyoming	99,150	3,600	103,600	99,000
Total United States	4,770,750	325,410	5,118,760	4,763,700
Change from previous week	up 7,050			

Total production January 1-March 10, 1945 ..... 326,978,450 bbl.
Same period last year ..... 307,656,905 bbl.

TEXAS GULF COAST

Fayette County Discovery Has Potential of 80 Bbl.

HOUSTON.—Continental Oil Co. 1 E. A. Arnim, Jr. et al, discovery well 8 miles northwest of Flatonia, in Fayette County, P. J. Menefee 1/3 league, is completed as a pumper in 35 perforations at 2,050-59 ft. Potential is 80.52 bbl. daily, no gas, gravity 20°, 0.1 per cent water. Total depth is 5,405 ft., plugged back to 2,120 ft. Sand was topped at 2,040 ft., and 6-in. casing set at 2,040 ft.

Navarro Oil Co. 1 Foster Lumber Co., discovery well in Geo. Taylor Survey, San Jacinto County, on final potential test flowed 74.58 bbl. daily through 3/16-in. choke, gas-oil ratio 12,500, tubing pressure 1,000 lb., casing pressure 2,250 lb., gravity 38.5°, no water, from perforations at 7,906-10 ft. Total depth is 7,960 ft., with 5½-in. casing set at 7,960 ft. Top of Wilcox sand zone was cut at 7,883 ft. Completion was made after a series of tests in the 7,900-ft. sand level, operator having been unable to cut down high gas-oil ratio but eliminating salt water successfully.

Skelly Oil Co. et al 1 Hardy & Horn, a wildcat about a mile east of Bay City in Matagorda County, perforated at 10,276-82 ft. for a new test. Total depth of the hole is 10,844 ft. in sandy shale, 7-in. casing set to 10,461 ft., top of cement 10,282 ft. A previous test in perforations at 10,316-22 ft., using ⅜-in. and ¼-in. chokes, flowed 22 bbl. fluid, 92 per cent being 41.6°-gravity condensate and 8 per cent fresh water, gas-oil ratio 125,061. The water is reported to have increased and perforations were squeezed.

General Crude Oil Co. 17-B Esperson (drilled as 1-C) at South Esperson field in Liberty County, flowed a potential of 135.13 bbl. per day through ⅛-in. choke, gas-oil ratio 770, tubing pressure 800 lb., gravity 37.1°, 0.4 per cent water. Total depth is 6,174 ft., with 5½-in. casing set at 6.040 ft. Completion was in perforations at 5,940-45 ft., 5,955-70 ft. and 5,975-85 ft. This well extends the South Esperson field westward, being 2,400 ft. west and a little south of the 15-B Esperson well, nearest producer.

At the Mayes field, Chambers County, Humble Oil & Refining Co. is completing the 3 M. E. Mayes, north offset to the discovery well and second producer for the field. Total depth is 8,550 ft., with 5½-in. casing set at 8,267 ft., perforations at 8,166-69 ft., it flowed 29.79 bbl. hourly on preliminary tests through ¼-in. choke, tubing pressure 1,250 lb., casing pressure 1,200 lb., gas-oil ratio 615 to 1, gravity 40.6°.

SUCCESSFUL WILDCAT COMPLETIONS IN UPPER GULF COAST TEXAS

Fayette County: New pool discovery. Continental 1 E. A. Arnim, Jr., et al, J. S. Menefee 1/3 Lge., 5 mi. NW of Flatonia, TD 5,405 ft., PBTD 2,120 ft., with 6-in. casing set at 2,040 ft., and 75 ft. of 4½-in. liner, 2-in. at 1,500 ft., perf. at 2,050-59 ft., PT 80.52 bbl. per day pumping, no gas, gravity 20°, 0.1 per cent water.

Liberty County: South Esperson pool ex-

tension. General Crude 17-B (1-C) Sun Oil (Esperson "B"), F. M. Gardner Sur., 2,400 ft. West and a little south of the 15-B Esperson well, nearest producer, TD 6,174 ft., PT 135.13 bbl. per day, ½-in. choke, 37.1°-gravity oil, gas-oil ratio 779, tubing pressure 800 lb., water 0.4 per cent.

San Jacinto County: New pool discovery. Navarro Oil 1 Foster Lumber Co., Geo. Taylor Sur., TD 7,960 ft., perf. at 7,906-10 ft. in Wilcox, PT 74.50 bbl. per day, 3/16-in. choke, gas-oil ratio 12,500, tubing pressure 1,000 lb. casing pressure 2,250 lb., gravity 38.5°, no water.

N. CENTRAL TEXAS

Offset to Discovery Has Deeper Pay Zone

WICHITA FALLS.—Ohio Oil Co. 2 W. R. Ross, Block 24, R. B. Masterson Survey, east offset to 1 Ross, discovery in Ross Strawn pool of King County, drilled lime showing oil at 5,374-81 ft. A drill-stem test at 5,368-86 ft. recovered 100 ft. of oil-cut mud with bottom-hole pressure of 2,250 lb. in 10 minutes. It is drilling below 5,407 ft. This is a deeper pay zone than that of 1 Ross which had top pay at 5,230 ft. with total depth of 5,257 ft.

Big Six Oil Co. 1-A Schloffke-Morris, Section 3, Block 11, H&TC Survey, has been completed to open pay in the lower bend of the Big Six pool of eastern Wilbarger County. On potential gage the test pumped 62½ bbl. of 45° gravity oil in 24 hours. The pay section is 4,830-74 ft. Total depth is 5,146 ft.

Clay County—Continental Oil Co. 1 Thomas, wildcat in Block 37, Freestone County School Land, 2 miles north of Newport, is drilling below 5,157 ft. in shale. Fain & McGaha et al 1 W. C. Frey, Parker County School Land, wildcat 5 miles south of Petrolia, is drilling ahead at 4,997 ft. in shale and lime. Consolidated Oil Co. 1 Schulz & Myers, J. H. Belcher Survey, half way between the Joy and Southerland pools, is dry at 6,091 ft.

SUCCESSFUL WILDCAT COMPLETIONS IN NORTH CENTRAL TEXAS

Jack County: Pool extension. Hanlon & Buchanan 1 J. H. Shown, J. B. Irvine Sur. A-312, 8 mi. W Avis, elev. 1,057 ft., pumped 62 bbl. day, TD 3,478 ft.

WILDCAT FAILURES COMPLETED IN NORTH CENTRAL TEXAS

Archer County: Republic Natural Gas 2 W. L. King, Wm. Henry Sur. A-163, 1 mi. E Archer City, dry, TD 1,410 ft.

Clay County: J. C. Jennings 1 Kempner, Blk. 17, Bosque CSL, 3 mi. SW Petrolia, dry, TD 6,141 ft.

Shappell Oil 1 Zelma Roberts, Blk. 74, Parker CSL, 5 mi. SE Petrolia, dry, TD 2,008 ft.

Childress County: C. A. Beasley et al 1 W. T. Lowe, Blk. H, W&NW Ry. Sur. No. 417, 3½ mi. SE Kirkland, dry, TD 2,990 ft.

Cooke County: Geo. W. Graham et al 1 Will Sicking, M. Langham Sur. A-564, 5 mi. S and 3 mi. E Muenster, Ellenburger 1,984 ft., dry, TD 2,113 ft.

Throckmorton County: Bridwell Oil 1 Mrs. Zula Morrison, Sec. 2, W. E. Crump Sur. A-183, 13 mi. S Throckmorton, elev. 1,304 ft., dry, TD 1,365 ft.

A. B. Bissey 1 D. K. Robinson, Sec. 224, BBB&C Sur., 3 mi. W and 5 mi. S Throckmorton, elev. 1,433 ft., dry, TD 777 ft.

WEST CENTRAL TEXAS

ABILENE.—E. H. R. Sabens 1-B W. H. Green, Section 71, Block 12, T&P Survey, is a new shallow pool discovery 1 mile south of the nearest production in southern Shackelford County. It is producing an estimated 20 bbl. of oil in 24 hours from the Tannehill sand section at 959-971 ft. Jones & Stasney-Roark 1 W. H. Green, Section 47, Block 11, T&P Survey, 6 miles south of Albany, Shackelford County, after encountering oil saturated sand in the basal Marble Falls, is drilling ahead at 4,485 ft.

SUCCESSFUL WILDCAT COMPLETION IN WEST CENTRAL TEXAS

Shackelford County: New gas pool discovery. Eltex 1 G. R. Davis, Sec. 57, Blk. 13, T&P Sur., 10 mi. S Budmathews, elev. 1,840 ft., IP 3,400,000 cu. ft. gas per day from Hope at 1,808-12 ft., shut-in pressure 400 lb., TD 1,815 ft.

WILDCAT FAILURES COMPLETED IN WEST CENTRAL TEXAS

Coleman County: H. T. Owens and Rhodes Drilling 1 Mrs. Della McCain et al, Sec. 14, SPRR Sur., 4 mi. SW Novice, elev. 1,998 ft., Gardner 3,700 ft., dry, TD 3,902 ft.

Stephens County: Hill & Hill 1 A. E. Harvey, Sec. 42, Blk. 4, T&D Sur., 1 mi. E Caddo, elev. 1,359 ft., Caddo 3,189 ft. dry, TD 3,391 ft.

PERMIAN BASIN

Andrews County Test Flows 40°-Gravity Oil

MIDLAND.—Stanolind Oil & Gas Co. 1-P University, Section 44, Block 13, University lands, a wildcat in central Andrews County, 3½ miles south of Mid-Continent Petroleum Corp. 1-7 University, Siluro-Devonian discovery well in the Fullerton district, cored the Fullerton zone from 6,960-7,143 ft. and showed slight porosity and stains. Base of Permian was logged at 8,385 ft., and Devonian was topped at 8,760 ft. Drill-stem test was run at 8,742-75 ft. and recovered 1,050 ft. of water blanket with sweet gas to surface in 37 minutes. It flowed water blanket for 40 minutes then started flowing 40°-gravity oil. Total depth is 8,775 ft. This had been a tight well until this information was released. Stanolind 1-D University, Devonian lime pool opener in southwestern Andrews County, 5 miles northwest of the Embar pool, has been completed. On potential gage it flowed 289 bbl. of 41°-gravity oil in 24 hours through ¼-in. tubing choke from 8,300-55 ft. through perforations. This test was plugged back from a total depth of 10,466 ft. after failure in the Ellenburger, topped at 10,057 ft. Magnolia Petroleum Co. 1-A Ralph, wildcat 1 mile west of the Fullerton pool, was preparing to run a drill-stem test at 10,727 ft. in hard brown dolomite.

Rowan Drilling Co. 1 TXL, 2¾ miles southeast of Shell Oil Co. and Cities Service Oil Co. 1 TXL, Ector County, discovery well, ran a 1-hour drill-stem test from 7,877-7,920 ft. Gas came to the surface in 3 minutes. After 3,600 ft. of drill pipe was pulled, the well unloaded for 12 minutes. Then 7,140 ft. of drill pipe was pulled and well unloaded for 5 minutes. When all drill pipe was broken down, 360 ft. of clean oil and a small amount of drilling mud was recovered. Drilling will continue to 7,970 ft. where drill-stem test will be made. Humble Oil & Refining Co. 1 Shell-fee, 1-mile east extension to the Eubank pool in southern Gaines County, swabbed 6 bbl. of fluid per hour on a 24-hour test, 50 per cent oil and 50 per cent water, through perforations at 7,065-7,105 ft. and 7,115-75 ft. after acidizing with total of 13,000 gal. of acid. Testing will be continued. Humble 1 J. M. Parrott et al, wildcat in eastern Upton Coun-

(Continued on Page 158)

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APPALACHIAN FIELD

High Water Slows Work In Eastern Fields

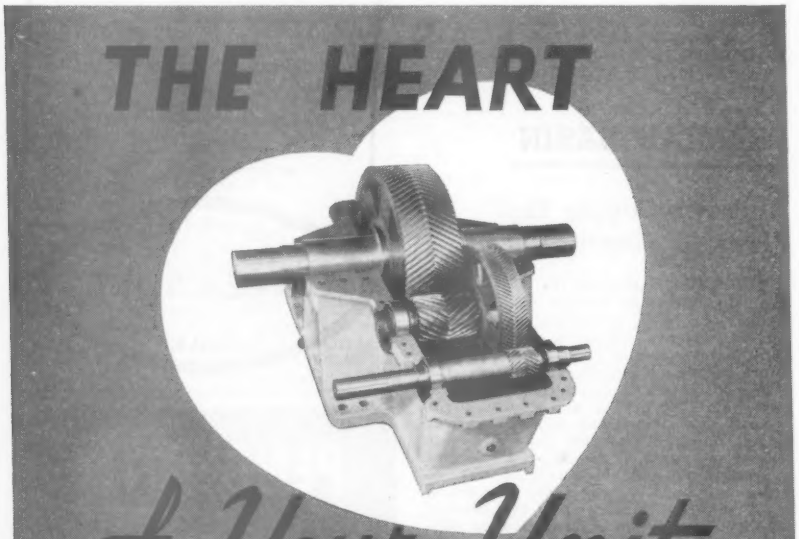
PITTSBURGH.—Badly flooded districts of the lower eastern fields prevented considerable work in the oil and gas fields but it is believed that no serious damage has been done. Pipe-line traffic was halted in many sections but operations were generally resumed within a day.

In West Virginia, United Fuel Gas Co. has started work on an Oriskany test east of the southern tip of the Elk-Poca gas field as the result of a 10,000,000-cu. ft. well on the Edward Gebhart farm which was completed last fall. The new test is drilling at 250 ft. and is located on Julia Welch farm on Billy Run on Blue Creek. A location has been made on the Fred J. Thabet farm with a starting elevation of 976 ft.

In the new gas field in Jefferson district, Nicholas County, Columbian Carbon Co. is drilling in the Big lime in No. 774 C. C. Dickinson. The Big lime was topped at 1,372 ft., and 189,000 cu. ft. gas showed at 1,445-1,500 ft., which after being acidized with 1,000 gal., had a gage of 684,000 cu. ft. with a rock pressure of 525 lb. in 15 hours. It is being deepened to the Injun sand.

In Wirt County, the deep test of Godfrey L. Cabot, Inc. on Annie B. Smith farm in Elizabeth district, struck a gas pocket in the Marcellus black lime at 5,473 ft. which blew the tools up the hole and resulted in a bad fishing job.

In Wyoming County, Hope Natural Gas Co. is completing 8,869 Loup Creek Colliery Co. in Oceana district after shooting the Berea which had a show of 15,000 cu. ft. gas and final open flow of 71,000 cu. ft. before cleaning out. The Big lime was at 2,704-3,060 ft.; Berea 3,614-45 ft.; gas at 3,640 ft. In Baileysville district, this company has made a location for 8,959 New River and Pocahontas Consolidated Coal Co., with a starting elevation of 1,357 ft.



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CANADIAN FIELDS

Turner Valley Well Makes 580 Bbl. Daily

CHATHAM.—Official figures have just been issued on a recent group of Turner Valley completions.

North Extension, British Dominion 6, LSD 6, 17-21-3w5, TD 10,238 ft. Madison at 7,910 ft. made 580 bbl. daily of 41°-gravity crude with 2,130,000 ft. gas.

North Turner Valley.—Foothills Oil & Gas 19, LSD 10-11, 27-20-3w5, TD 9,023 ft., Madison 6,059 ft., made 480 bbl. daily 40°-gravity, with 974,000 cu. ft. gas.

North Central.—Royalite Oil 79, LSD 7, 2-2-20w5, TD 7,937 ft., Madison 7,576 ft., 299 bbl. daily 41°-gravity, with 495,000 cu. ft. gas.

Tempest.—In the Tempest area, southern Alberta, Imperial-Tempest 1, LSD 4, 27-9-19w4, is in Devonian at 5,048 ft. and testing production. Tests will also be made of good showings in the overlying Madison limestone.

Saskatchewan.—In southern Saskatchewan, Imperial-Elbow 1, LSD 12, 25-23-6w3, is dry at 5,567 ft.

Suffield.—In the Suffield area, southern Alberta, National Defense 5, LSD 15, 22-15-9w5, a test for gas, dry at 950 ft.

EASTERN TEXAS

Test Staked Southwest Of Condensate Strike

DALLAS.—The Texas Co. has staked a test 4,200 ft. south and slightly west of 1 McKnight, new condensate discovery which is 2½ miles southwest of Fairfield in Freestone County. It is 1 Dr. W. N. Sneed, located 1,400 ft. from the north line and 600 ft. from east lines of tract and B. Green Survey. A failure for Henderson County is Gulf Oil Corp. 1 T. D. Frizzell, David Cherry Survey, 1 mile east of Baxter. Total depth is 11,687 ft.

Humble Oil & Refining Co. 1 New Birmingham, Jordan Survey, Travis Peak wildcat in southwestern Cherokee County, is drilling below 9,603 ft. in lime and shale with no shows. Humble 1 S. T. Stanley, Vaughn Survey, in the Larissa area of northwestern Cherokee County, swabbed and tested through perforations at 8,480-8,560 ft. and recovered 20.31 bbl. of 38.8° gravity oil, 3 per cent basic sediment and water, during 7 hours. Total depth is 10,737 ft.

SUCCESSFUL WILDCAT COMPLETIONS IN EASTERN TEXAS

Hopkins County: Pool extension. Humble 1 Nichols, Antonio Lazarin Sur., 1½ mi. S Pickton, elev. 481 ft., Paluxy 6,315 ft., massive anhydrite 7,760-7,890 ft., Bacon 7,890-7,910 ft., flowed 460 bbl. per day through ¼-in. choke from perf. at 7,895-7,905 ft. in the Bacon, gravity 50.8°, gas-oil ratio 1,280, TD 7,940 ft.

Freestone County: New pool discovery.

Texas 1 W. A. L. McKnight, L. H. Reed Sur., 3 mi. SW Fairfield, elev. 458 ft., Rodessa porosity 7,227 ft., James 7,630 ft., Pettit porosity 7,793 ft., flowed 14,600,000 cu. ft. gas per day with est. 30 bbl. condensate per million cubic feet of gas from Travis Peak, perf. at 8,232-47 ft. and 8,275-97 ft., gravity 60°, TD 8,903 ft.

Panola County: Condensate extension to gas field. Ark.-La. Gas 1 Z. L. Daniel, Matthew Parker Sur. A-527, 6 mi. SW Carthage, elev. 334 ft., dual completion, flowed 18,000,000 cu. ft. gas per day from perf. at 5,901-28 ft. in the upper Pettit, flowed 10,600,000 cu. ft. gas per day from perf. at 6,054-6,115 ft. in the lower Pettit, total condensate est. 30 bbl. per million cubic feet gas, TD 6,471 ft.

WILDCAT FAILURE COMPLETED IN EASTERN TEXAS

Wood County: Delta 1 W. S. and M. Mosely, Seth W. Mitchell Sur., 7 mi. NE Quitman, elev. 460 ft., Woodbine 5,246 ft., dry, TD 6,015 ft.

WILDCAT COMPLETIONS AND DISCOVERIES

	Week ended March 10, 1945					Cumulative total, 1945				
	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ohio	0	0	1	0	1	0	0	5	11	16
Indiana	0	0	0	0	0	0	0	0	2	2
Illinois	0	0	0	1	1	11	0	0	42	53
Kentucky	0	0	0	0	0	2	0	1	9	12
Michigan	0	0	0	5	5	1	0	0	42	43
Kansas	2	0	0	2	4	7	0	3	66	76
Neb., Mo., Iowa	0	0	0	0	0	0	0	0	7	7
Oklahoma	2	0	0	11	13	23	0	2	55	80
Texas:										
North Central	1	0	1	9	11	28	0	3	89	120
West	0	0	0	6	6	6	0	0	59	65
Panhandle	0	0	0	1	1	0	0	0	3	3
Eastern	1	2	0	1	4	5	2	0	16	23
Gulf Coast	3	0	0	6	9	12	1	8	55	76
Southwest	2	0	0	3	5	5	0	3	40	48
Total Texas	7	2	1	26	36	56	3	14	262	335
Louisiana:										
Northern	0	0	0	1	1	1	0	1	15	17
Southern	0	0	0	2	2	4	0	0	9	13
Total Louisiana	0	0	0	3	3	5	0	1	24	30
Arkansas	0	0	0	0	0	0	0	0	13	13
Mississippi	0	0	0	5	5	1	0	0	23	24
Ala., Ga., Florida	0	0	0	0	0	0	0	0	4	4
Montana	0	0	0	0	0	3	0	0	3	6
Wyoming	0	0	0	1	1	6	0	0	8	14
Colorado-Utah	0	0	0	0	0	0	0	0	3	3
New Mexico	0	0	0	0	0	3	0	0	16	19
California	0	0	1	4	5	0	0	2	40	42
Total United States	11	2	3	58	74	118	3	28	630	779
Total previous week	23	0	2	56	81					

ILLINOIS

1,700-Bbl. Well in North Sims, Wayne County

CENTRALIA.—In a period in which heavy rains and overflow from the Wabash and Ohio rivers have delayed field work all over the tristate area of Illinois, Indiana and western Kentucky, the largest well in several weeks was completed on the northwest edge of the North Sims field in Wayne County, Illinois. Dee Miller Drilling Co. 1 Sarah M. Weaver, SE SW NW 9-1s-6e, flowed an average of 1,720 bbl. per day for several days. McClosky lime was found at intervals from 3,156 to 3,215 ft. Pipe was penetrated with 48 holes at 3,210-18 ft. without success, and the hole was plugged back to 3,171 ft. and pipe penetrated with 46 holes at 3,152-69 ft. The well flowed 792 bbl., naturally, in 24 hours, but after an acid treatment it flowed 1,783 bbl., 1,703 bbl. and 1,703 bbl. for the next 3 days. The location is a mile southwest of the Johnsonville pool as well as an extension to North Sims.

Only nine other wells were completed during the week ranging from 20 bbl. to 250 bbl. per day in initial production. Nine dry holes were reported, including one wildcat.

Magnolia Petroleum Co. 1 Fletcher Stanley, SW SW NE 12-4n-8e, Clay County, a wildcat, 5 miles northeast of Sailor Springs, had Rosiclare lime at 3,003-05 ft., total depth, and before it was acidized swabbed from 11 to 16 bbl. of oil per hour. It was then acidized and was being given a production test. There is a dry hole at 3,148 ft. in the NE SE NW 11-4n-8 that was drilled by George Hinterscher, and another dry hole 2½ miles south, Ohio Oil Co. 1 Negley, SE NE SW 24-4n-8e, total depth 3,150 ft.

Four miles southwest of Carmi, White County, H. H. Weinert 1 Homer Kisner, SW NE SE 31-5s-9e, 2 miles from other oil producing wells, pumped 12 bbl. per hour from Levias (O'Hara) lime, at 3,118-36 ft. and McClosky lime at 3,139-45 ft., total depth 3,186 ft. It had been acidized through perforations.

Aetna Oil Co., George & Wrather Drilling Co., Haynes & Flynn 1 Greathouse, SW NE NW 23-1n-10e, Edwards County, wildcat, pumped 224 bbl. in 24 hours from McClosky lime at 3,247-54 ft., total depth 3,320 ft. It was not yet completed. It is 2 miles from other production.

The Illinois Geological Survey reports that one pool was discovered and five extensions made to pools in February. The new pool has been named Keenville, and is located in Wayne County. The Clay City field was extended in two places and the Albion East pool in Edwards County; Thackeray in Hamilton, Leach Township, in Wayne were also extended. New pays were opened in Waltersburg sand in the Cowling pool in Edwards County and the McClosky lime in the Herald pool in White County. The initial production of the February crop of completions was the highest since October in 1943. Compared with February a year ago the average was 152 bbl. as against 119 bbl. a year before.

WILDCAT FAILURE COMPLETED IN ILLINOIS

Richland County: Pure 1 J. E. Stiff-A, SW SE SE 33-5n-10e, dry at 3,057 ft., McClosky lime at 2,961-64 ft.

MICHIGAN

Disappointing Week In Well Completions

SAGINAW.—Sixteen completions in a dozen Michigan counties in the past week were mostly disappointments, with 11 tests resulting in dry holes, one in a small gas well, and the other four in small crude producers. Meanwhile, the plans for expanded exploration continued with 18 new drilling permits being issued by the state conservation department. The locations include four in Allegan County, three in Van Buren, two each in Bay, Isabella and Montcalm, others in Ottawa, Arenac, Clinton, Osceola and Huron counties.

WILDCAT FAILURES COMPLETED IN MICHIGAN

Bay County, Gibson Township: H. E. Walton-William B. Stewart 1 Agnor, NE NE NW 27-18n-3e, dry in Dundee, TD 3,060 ft.

Kent County, Tyrone Township: Neil Wagenaar et al 1 Barrett, SE SE NE 23-10n-12w, dry in Monroe, TD 2,830 ft.

Lake County, Ellsworth Township: Rowmor Corp.-Americrude Oil 1 Lucius, NW NW NW 22-19n-11w, dry in Monroe, TD 3,658 ft.

Ottawa County, Olive Township: Clifford A. Perry 1 Van Beek, SW SW SE 24-6n-15w, dry in Traverse limestone, TD 1,677 ft.

Tuscola County, Elmwood Township: J. V. Wicklund Development 1 Comment, NW SW SE 3-14n-10e, dry in Monroe, TD 3,660 ft.

SOUTH LOUISIANA

Humble Perforating at Lafourche Parish Test

NEW ORLEANS.—Humble Oil & Refining Co. 2 Price, 25-15s-22e, deep sand test at Delta Farms field, Lafourche Parish, squeezed perforations after testing gas at 10,350-52 ft., and set plug at 9,463 ft. Operators are now preparing to reperforate at 9,447-50 ft. Five and one-half-inch casing set at 10,407 ft., with total depth at 12,000 ft.

Stanolind Oil & Gas Co. is moving in workover rig to test 1 Tupper, 29-7s-3w, at South Elton field, Jefferson Davis Parish. Several good shows were reported with sand at 8,070-87 ft. showing 37.4° gravity oil. Total depth the hole is 9,255 ft., with 7-in. casing set at 9,254 ft.

Tide Water Associated Oil Co. et al 1 Lussier, 58-12s-14e, at Napoleonville field, Assumption Parish, is completed as a gas well and shut in, no gage available. Total depth is 10,982 ft. with 5½-in. casing set to 10,528 ft., perforations 100 holes from 9,796-9,806 ft.

WILDCAT FAILURES COMPLETED IN SOUTH LOUISIANA

Acadia Parish: Sun Oil 1 Estherwood Townsite Unit, 50-10s-1w, Estherwood area, dry at 11,363 ft.

Cameron Parish: Amerada 2 Glassell et al, in Mallard Bay area, T-13s-3w, dry at 9,768 ft.

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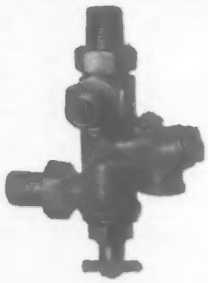

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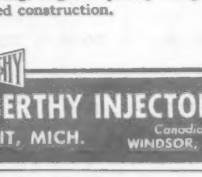

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CALIFORNIA

New North Rio Vista Gas Field Is Opened

LOS ANGELES.—Standard Oil Co. has discovered a new commercial gas field about 4 miles north of the Rio Vista gas field and although the discovery well only flowed at a daily rate of 14,000,000 cu. ft. per day from 4,810 ft. the field will probably prove of major importance as the discovery well was producing from only 10 ft. of perforations. This new well was finished in the Midland zone which has proved very prolific at Rio Vista and there is every reason to believe it will likewise prove highly productive at North Rio Vista. The Midland zone is a thick body and contains about 85 ft. of productive formation at Rio Vista. Standard's discovery well is 2 Calpak and is located on about 1,400 acres of property leased from the California Packing Co. That the new discovery represents a separate field is indicated by the fact that three dry holes have been drilled between the discovery and nearest production at Rio Vista. The Rio Vista gas field is the best commercial gas field in California and for this reason development work in the North Rio Vista area will be watched with interest.

In addition to discovering a new gas field north of Rio Vista, Standard successfully completed another good well in the Anderson sand at Rio Vista. The Anderson sand, deepest known productive gas sand at Rio Vista, was discovered by Standard in August of last year. It is reached at approximately 6,250 ft. and only a relatively few wells have been finished in this zone to date. Shell completed its second well in the Kirby Hills gas field a few days ago but the company did not make a flow test, being content with blowing the hole clean and then shutting the well in. The discovery well in this field was lost by a gas blowout of several days duration but a substitute well was successfully completed late in 1944.

Amerada Petroleum Corp. has completed a new gas well in the Dixon district of Solano County but there is some question as to whether this new well is located on the Dixon anticline or on a separate accumulation. Amerada has drilled several exploratory wells in this general area where it has substantial holdings of productive and potentially productive acreage. Amerada's new well is 1 Wineman in Section 26-6n-2e and it was drilled to 5,000 ft. and redrilled to 4,790 ft., at which point 143 ft. of 4-in. blank liner was landed and subsequently gun perforated at 4,769-89 ft. Amerada discovered the Dixon gas field in 1 Starkey, located in Section 2-6n-2e, in September 1944, and has subsequently drilled a series of dry holes in an attempt to define the limits of the accumulation. One successful wildcat was located several miles southeast of the Amerada's discovery well and another wildcat was located several miles due south of the field. Amerada has been one of the most successful prospectors in the state for several years in both gas and oil discoveries.

SUCCESSFUL WILDCAT COMPLETION IN CALIFORNIA

Solano County, North Rio Vista: Standard 2 Calpak, 6-4n-3e, flowed 14,000,000 cu. ft. gas, no oil, 64/64-in. bean, Hamilton sand 4,765 ft., TD 4,840 ft., PB 4,810 ft., perf. 4,760-4,810 ft., new gas discovery in Eocene, located 4 miles north of Rio Vista gas field.

WILDCAT FAILURES COMPLETED IN CALIFORNIA

Kings County, Alpaugh: Standard 1 Mortgage Guarantee, 25-23s-21e, bottomed in Etchegoin gray sand, First Mya 2,761 ft., B zone 2,779 ft., Fifth Mya 4,530 ft., Etchegoin 4,596-4,793 ft., form. test 4,655-93 ft. recovered 2,751 ft. mud and salt water, TD 4,793 ft., dry.

Kern County, Lindsey Hills: Standard 1 Notz, 18-28s-22e, bottomed in gray sand, all sands tested wet, TD 6,536 ft., dry.

San Luis Obispo County, Temblor: Richfield 2-1 Temblor unit, 27-32s-22e, bottomed in sand, bailed dry several times, fair showing of oil, zone apparently barren, TD 4,472 ft., dry.

Fresno County, Tranquillity: Standard 74 Patterson, 3-16s-14e, bottomed in Cretaceous gray sand, Temblor 5,695 ft., Kreyenhagen 6,259 ft., Green sand 7,252 ft., Domengine 7,256-78 ft., Cretaceous 8,284 ft., TD 8,710 ft. ,dry.

LA.-ARK.

Atlanta Field Gets Probable New Producer

SHREVEPORT.—In the Arkansas fields, Tide Water Associated Oil Co. and Seaboard Oil Co. are expected to complete their 1 Davis, NE NW 17-18s-19w, as a good producer to add to the Atlantic pool in Columbia County. The well was perforated after setting casing at 8,288 ft., and had a good show of oil. Two new locations of interest have been staked in Columbia County this week. Mayfield Drilling Co. 1 Woodward, SE NE 6-17s-19w, three miles north of the Magnolia field, and G. H. Vaughan 1 McKissack, SE SE 18-16s-21w, are expected to start work as soon as the weather permits.

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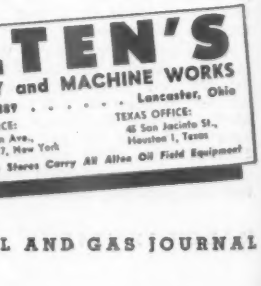

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Louisiana, W. C. Feazel et al 1 McIntyre, 12-13n-8w, wildcat, cored sand with good stain and odor of oil at 3,312-27 ft. Operators are preparing to set pipe and test the Eagleford.

Only four wells were completed in North Louisiana this week, one wildcat and three field tries. The wildcat and one field well were dry, but Holly Ridge pool got a new producer in the Tide Water-Seaboard 1 Jurden-Marks, NW NE 29-11n-10e, which made 227 bbl. per day from the Massive sand at 8,344-54 ft. Caddo pool added a well in the W. B. Johnson Drilling Co. 3-B Stiles, SE NE NE 21-21n-16w, which had an initial of 70 bbl. of oil from 2,303-06 ft.

WILDCAT FAILURE COMPLETED IN NORTH LOUISIANA

Madison Parish: Press Cochrane 1 Frazier, NE NW 22-17n-10e, dry, TD 3,756 ft.

OKLAHOMA

Big Bend Pool in Osage Has Good Layton Sand Well

THE Big Bend pool in western Osage County, Oklahoma, came in for attention in the past week when A. G. Oliphant-C. B. Peters No. 4, SW SW SE 20-25-3, gaged as high as 490 bbl. per day, natural flow, from Layton sand at 2,834-53 ft., total depth. It is the largest well thus far drilled in the field.

A roundup of statistics on field operations in West Edmond, in Oklahoma, Kingfisher, Canadian and Logan counties, shows 428 oil wells producing from Hunton lime, 10 from Bartlesville sand and 1 showing distillate in Prue sand. Eighty-six wells were drilling, 38 fewer than early in January. An estimated 100 locations in the field remained to be drilled. Production is around 63,000 bbl. per day.

The Prue sand well above referred to is Sohio Petroleum 1 Patten-B, C SW SW 27-14n-4w, Oklahoma County. The well showed a production of 7,000,000 cu. ft. of gas and 8 to 9 bbl. per hour of distillate through casing perforations at 6,412-36 ft. The crew was preparing to shut off the production until the Hunton lime, yet to be reached, is tested.

Down in the southern edge of the field Stanolind Oil & Gas Co. 1 Urschel, C NW NE 33-13n-4w, Oklahoma County, was completed. It flowed 239 bbl. of net oil in 22 hours through ¾-in. choke on tubing.

The Atlantic Refining Co. has been added to the list of producing companies in West Edmond. Its 1 Trindle, C SE SE 25-15n-5w, Kingfisher County, was completed in Hunton lime topped at 7,195 ft., total depth 7,234 ft. It was good for about 275 bbl. per day.

Another new producer in the West Edmond is Ilco Corp. Its 1 Hunsiker, C NW SE 24-14-5w, Canadian County, was completed in Bartlesville sand at 6,817-45 ft. It made 20 bbl. per hour through ⅛-in. choke. It had been drilled to 7,107 ft., but found water in the Hunton lime.

Ohio Oil Co. has opened a new producing zone in the East Pauls Valley pool in Garvin County in 1 Chisholm, SW NW NW 13-3n-1e. Salt water appeared in the McLish zone and in the deeper Oil Creek section at 3,840-53 ft. the well showed 10,000,000 cu. ft. of gas and a spray of distillate and oil. It was not yet completed.

Gulf Oil Corp. et al 1 Price, C NE SE 17-9n-3w, a wildcat south of the West Moore field in Cleveland County, found Wilcox sand dry at 9,402-18 ft., and was being plugged back to test Cleveland sand around 6,875 ft. Wilcox sand was dry in another Cleveland County test, O. G. Harp 1 Mattheson, NE NW NE 19-10n-2w, which found the Wilcox at 8,930-65 ft. and

(Continued on Page 158)

ROCKY MOUNTAIN

Several Deep Tests Scheduled for This Year

DENVER.—Wildcat wells in the Rocky Mountain area scheduled to go to a depth of 10,000 ft. or more this year are more numerous than heretofore reported. Five of these are now drilling and at least three more are expected to get under way within the next few months. The locations for the latter have not yet been released but one of them probably will be in the Powder River basin in northeastern Wyoming, one in Cole Creek and another in western Colorado.

The most southerly of the drilling tests is Southern Union Production Co. 9 Barker Creek, SE SE NW 21-32n-14w, San Juan County, northwestern New Mexico. At last reports it was coring in the basal Ouray at 9,250 ft., with the 7-in. at 8,938 ft., and is scheduled to go to the granite. Colorado has one 10,000-ft. well under way on Wilson Creek, Rio Blanco County, in The Texas Co.-California Co. 20 unit, NE SW NE 34-3n-94w. It has reached a depth of 8,276 ft. and is headed for the Weber formation which is productive at Rangely in the same county. It is, however, in a separate basin and is exploring the beds below the Sundance in that area for the first time. Regardless of whether it results in a discovery, it will prove to be an important test in that it will give a clue as to the probable thickness of formations in the Iles, Moffat, Thornburg and other structures to the north in Moffat County which have never been drilled below present producing horizons.

The Powder River basin test, which is reported to be scheduled for this summer, will be one of the most important of the deep tests as it will be a pioneer

(Continued on Page 158)

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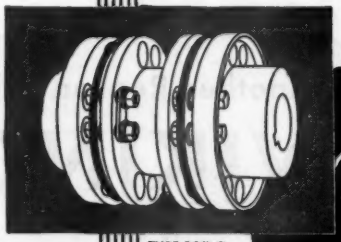

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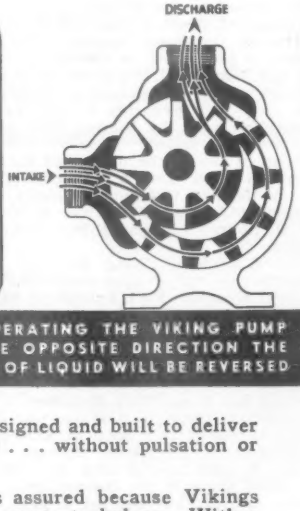

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SUMMARY OF FEBRUARY COMPLETIONS*

	Comp.	Oil	Prod.	Gas	Dry	Under 1,000 ft.	1,000-2,500 ft.	2,500-5,000 ft.	5,000-10,000 ft.	Over 10,000 ft.	Total footage	Rigs and drilling
New York	84	42	50	0	†42	0	74	10	0	0	102,600	96
Pennsylvania	242	117	175	12	‡113	18	205	19	0	0	332,577	260
West Virginia	66	3	15	55	8	0	28	38	0	0	171,542	73
Ohio	59	15	384	17	27	6	12	40	1	0	177,107	171
Indiana	13	4	284	0	9	2	6	5	0	0	28,374	31
Kentucky	36	9	910	14	13	1	19	16	0	0	73,716	43
Michigan	48	24	10,423	2	22	0	17	31	0	0	129,632	130
Illinois	122	78	12,385	1	43	3	44	75	0	0	320,297	172
Kansas	109	48	17,320	6	55	0	12	96	1	0	367,081	244
Neb., Mo., Iowa	2	0	0	0	2	2	0	0	0	0	1,071	7
Oklahoma	193	130	66,393	14	49	9	40	64	80	0	831,680	536
Texas:												
North Texas	123	64	5,802	0	59	28	52	31	12	0	295,510	90
West Central Texas	36	11	2,063	5	20	0	13	22	1	0	108,811	36
West Texas	157	109	53,789	0	48	6	12	74	63	2	741,606	532
Texas Panhandle	45	22	3,358	22	1	0	1	44	0	0	140,775	177
Eastern Texas	22	6	1,243	7	9	0	0	1	20	1	160,341	102
Upper Gulf Coast	57	31	5,985	5	21	0	1	7	41	8	418,977	121
Lower Gulf Coast	64	35	5,455	9	20	0	1	5	57	1	419,804	102
S.C. Texas (S. A.)	5	3	684	0	2	0	0	3	2	0	26,442	21
South Texas (Laredo)	43	17	1,550	4	22	2	4	20	17	0	197,237	59
Total Texas	552	298	79,929	52	202	36	84	207	213	12	2,509,503	1,240
Louisiana:												
Northern Louisiana	19	11	2,881	4	4	0	2	4	13	0	114,304	69
Southern Louisiana	46	36	7,986	1	9	0	0	3	24	19	412,492	123
Total Louisiana	65	47	10,867	5	13	0	2	7	37	19	526,796	192
Arkansas	11	2	195	0	9	0	1	7	3	0	50,691	26
Mississippi	26	14	2,269	0	12	0	0	2	17	7	186,242	77
Ala., Ga., Florida	2	0	0	0	2	0	0	2	0	0	8,608	22
Montana	22	10	1,263	7	5	6	8	5	3	0	51,272	106
Wyoming	12	10	3,005	0	2	0	1	5	6	0	56,292	79
Colorado-Utah	2	1	180	0	1	0	1	1	0	0	5,818	36
New Mexico	35	23	3,828	0	12	2	5	21	7	0	126,663	64
California	184	149	37,850	4	31	17	23	107	32	5	707,125	270
Total February	1,885	1,024	247,725	189	672	102	582	758	400	43	6,764,687	3,875
Total January	1,857	1,022	249,952	177	§658	65	625	710	400	57	7,036,027	3,943

*Four weeks ending February 24. †Includes 42 service wells. ‡Includes 111 service wells. §Includes 128 service wells.

KANSAS

Graham County Strike Completed for 328 Bbl.

HELMERICH & Payne, Inc., 1 Luck, NE NE NE 13-8-22w, in Graham County, has been assigned a potential of 328 bbl. per day from the Kansas City lime at 3,414-20 ft. and 3,435-38 ft. Gravity of the oil is 35.6°. The Arbuckle, cut at 3,569 ft., was perforated before the well was plugged back to test the Kansas City, topped at 3,254 ft.

In Nebraska, the Fuerst Oil Development Co. 1 Dorsch, NW SW 6-20n-54w, in Scotts Bluff County, is preparing to drill-stem test an area of porosity and permeability at 5,234-50 ft. A strong show of gas was found in this area, and oil rainbow color was showing on pump. The hole is now at 5,275 ft.

SUCCESSFUL WILDCAT COMPLETIONS IN KANSAS

Graham County: Discovery. Helmerich & Payne 1 Luck, NE NE NE 13-8-22w, swabbed 35 bbl. oil per hour for 12 hours, gravity of clean oil 35°, potential 328 bbl., Lansing pay 3,418-38 ft., TD 3,610 ft., Kansas City 3,254 ft., conglomerate 3,561 ft., Arbuckle 3,569 ft.

Trego County. Discovery. Harbar & Greenburg, Tr. 1 Cotton, SW SW NE 15-12s-21w, swabbed 40 bbl. oil per day from pay zone 3,958-78 ft., TD 3,978 ft., Kansas City 3,605 ft., Marmaton 3,917 ft., conglomerate 3,954 ft., Arbuckle 3,958 ft.

WILDCAT FAILURES COMPLETED IN KANSAS

McPherson County: E. K. Carey et al 1 Leffler, NE NW NW 24-19s-1w, dry, TD 2,935 ft., elev. 1,586 ft., Mississippi lime 2,904 ft.

Stafford County: Republic Natural Gas 1 Asher, NW NW NE 1-24s-13w, dry, TD 4,038 ft., elev. 1,899 ft., Simpson 3,939 ft., Arbuckle 4,008 ft.

MISSISSIPPI

Gwinville Condensate Found in Lower Sand

JACKSON.—Gulf Refining Co. 1 Gholar, 510 ft. north and 654 ft. east of SW SW SE 27-9n-19w, in the Gwinville pool of Jefferson Davis County, has drill-stem tested gas-condensate at 8,353-61 ft., which is below water level of nearby wells. On a drill-stem test at 8,265-81 ft., 700 ft. of 41.2° gravity oil was recovered, with salt water. All sands cored from 8,281 ft. to 8,351 ft. carried salt water, however gas-condensate sand was again found at 8,351 ft. Irregularity of sands carrying productive shows in this area will necessitate an extensive coring program on each well until consistent water levels are proven.

WILDCAT FAILURES COMPLETED IN MISSISSIPPI

Claiborne County: Danciger Oil & Refining 1 Taylor, approx. NE NE NE 51-13h-3e, dry, TD 9,906 ft., lower Cretaceous 9,758 ft.

Copiah County: Arkansas Fuel Oil 1 Carraway, approx. SW SW SW 15-1n-3w, dry, TD 10,305 ft., Massive sand 10,041 ft., lower Cretaceous 10,185 ft.

Jeff Davis County: Humble 1 Dale, approx. SE SE SE NE 24-7n-18w, dry, TD 7,050 ft., Wilcox 2,270 ft., cap 2,530 ft.

Simpson County: Sinclair-Wyoming 1 Bishop, NW SE 13-2n-1e, dry, TD 9,545 ft., lower Cretaceous 9,446 ft.

Yalobusha County: Sid Onyette 1 Austin, SE SE SE 1-11s-6w, dry, TD 2,930 ft. in Paleozoic.

OHIO, KENTUCKY

Huntington Pool Is Extended One Mile West

COLUMBUS.—The Huntington pool in Lorain County was extended 1 mile to the west by Glen Harmon 2 H. C. Hicks, Lot 2, Huntington Township. Clinton sand was at 2,442-2,456 ft., and the well gaged 8,000,000 cu. ft. of gas.

A new gas pool was opened by Hanley & Bird in the northwest part of Grafton Township, Lorain County, by a successful completion of Rose Mlazovsky, Lot 22, Clinton was found at 2,490-2,504 ft., and gaged 3,297,000 cu. ft. The company will move one location to the north for the next test.

The Texas Co. is drilling in the Clinton sand in its deep wildcat in Belmont County. Sand is hard and no shows have been encountered.

SUCCESSFUL WILDCAT COMPLETION IN OHIO

Lorain County, Grafton Township: New gas field discovery. Hanley & Bird 1 Rose Mlazovsky, Lot 22, Clinton 2,490-2,504 ft., 3,297,000 cu. ft. TD 2,506 ft.

WESTERN KENTUCKY

OWENSBORO, Ky.—High water and deep mud have been the cause of numerous shut-downs in Western Kentucky. Sinclair Prairie Oil Co. completed 6 Bradley in 8-N-23, in the Poole area, in Henderson County. It had an initial production of 125 bbl. from Waltersburg sand at 1,829-44 ft.

EASTERN KENTUCKY

ASHLAND.—Completion of three gas wells, with a total open flow of 859,000

(Continued on page 155)

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Among the Drilling Contractors

Pike Drilling Co. has the contract to drill the British American Oil Producing Co. and The Texas Co. 2 Newhall Land & Farming Co. in the Newhall Potrero field in Section 21-4n-17w, in California. This property is located at the extreme western end of the Newhall Potrero structure, the property being proved up by The Texas Co. last year.

Wentworth-Emerick Drilling Co. had reached bottom-hole depth of 5,275 ft. on the Fuerst 1 Dorsch, in NW SW 6-20n-54w, Scotts Bluff County, Nebraska. Well was coring from 5,275 ft., testing oil show, and was preparing to make drill-stem test.

Ed J. Kubat, Oklahoma City contractor and independent operator, was moving in material for the 1 Staats, in NW NW SE 2-6n-1e, for a second Wilcox sand test east of Lexington in southern Cleveland County, Oklahoma. Skelly Oil Co., Champlin Refining Co., and Sinclair Prairie Oil Co. are supporting the test.

B. & M. Drilling Co., Los Angeles, composed of Bert Brunwin and Robert McKeon, is making good progress with Atha Exploration Co.'s 12-3 Newland, at the southeast end of Huntington Beach.

Perry - Busk - Ormiston has been awarded the drilling contract on the Rex Oil & Gas Co. 1 Elmer Curtis, in NE NE NE 15-3n-13w, Allegan County, Michigan.

C. B. Miller will drill the Alan W. Winchester 2 J. & L. Knoblock, in SE SW SW 22-3n-13w, Allegan County, Michigan.

Don Rayburn is the drilling contractor on the Basin Oil Co. and Don Rayburn 2 Stanley Neidwecki Comm., in NE NW SE 8-19n-4e, Arenac County, Michigan. Same operators will drill the 2 Peter Nowasielski, in NE NE SE 8-19n-4e, with contract going to **Goll, Graves & Mechling.**

Stuart Merrill has been awarded contract for two wells in Arenac County, Michigan, both for Lowell Bernhardt. One is the 1 Stanley Klimick, in SE NW NE 9-19n-4e, and the other is the 2 William Sinn, in NE NE NW 16-19n-4e.

J. C. Collins will drill the Rex Oil & Gas Co. 1 Alta Samuels, in NE SW NE 24-17n-11w, Lake County, Michigan.

Alberta Drilling & Development Co., of Calgary, Alta., is deepening Trans-Alberta-Twin Province 1, in 21-11-29w3, in the Maple Creek area, western Saskatchewan, to test Devonian limestone expected at 4,100 ft., after completing formation shut off at 3,741 ft. The test has already considerable gas and an oil show at 3,755 ft.

General Petroleums, of Calgary, Alta., is nearing completion with McColl-Frontenac Endon 1, in LSD 9, 29-6-7w4, a test of the Ellis sand in the Endon area of southwest Alberta.

N. R. Dodd is the drilling contractor on the Marvel Production Co. 3 Dykhuis-Pelon Comm., in NW SE NE 3-4n-15w, Allegan County, Michigan.

Helmerich & Payne, Tulsa drilling contractors and producers, have acquired all outstanding stock of Cardinal Oil Co. of Texas, with head-

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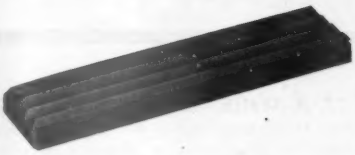

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SEE COMPOSITE CATALOG
PAGES 3101 TO 3120

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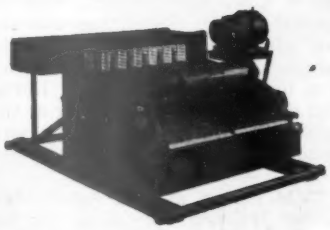

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quarters at San Angelo. The company operates 200 producing oil wells, and has a daily production of approximately 3,000 bbl. Consideration was reported to be in the neighborhood of $4,000,000.

R. D. Morgan is the drilling contractor on the J. L. Cates 1 J. A. Steel, Tr., in SW NW SW 6-21n-2e, Greene County, Alabama.

Parker Drilling Co. has been awarded drilling contract on the Humble Oil & Refining Co. 2 Ida Stowers, in Section 35-9n-2w, Adams County, Mississippi.

Stanolind Purchases Interest at Rangely

DENVER.—Stanolind Oil & Gas Co. is reported to have purchased an interest in the Husky Refining Co. holdings in the Rangely field, Colorado, and will supervise drilling operations. Husky holdings of approximately 840 acres are well located and are principally in Sections 32, 33, 34 and 35-2n-102w. Stanolind obtains first call on one-half of the production, the other half being under contract to the Wasatch Oil Refining Co.

Consideration is unofficially reported to have been around $750,000, but does not include any transfer of titles. Husky is drilling two Weber sand wells, 1 Hagood C NE SE 23-2n-103w, and 1 Rector NE SE 34-2n-102w. Stanolind's affiliate, the Utah Oil Refining Co., will build a pipe line from Rangely to Craig the coming spring, where it ties into a connection with the Utah's trunk line to Salt Lake City.

Kentucky Fields

(Continued from page 153)

cu. ft., and one oil well, highlighted operations in the eastern Kentucky fields during the week.

Kentucky-West Virginia Gas Co. completed No. 5,519 on the Emily Thacker land, located on Jonican Branch in Pike County, at a total depth of 3,992 ft., with a daily open flow of 328,000 cu. ft. of gas in shale, after shot.

Kentucky-West Virginia Gas also completed No. 5,545 on the G. W. Hall land, located on Mill Branch of Left Fork of Beaver Creek in Floyd County, at a total depth of 3,280 ft., with a daily open flow of 119,000 cu. ft. of gas in Maxon.

Kentucky-West Virginia Gas 5,570 Andrew Mitchell, located on Mink Branch of Big Mud Creek in Floyd County, was completed at a total depth of 3,253 ft., with a daily open flow of 412,000 cu. ft. of gas in shale, after shot.

Patterson Dyer and Rader completed No. 2 on the M. F. Stapleton farm, located on Sturgeon Creek in Jackson County, with an estimated daily production of two bbl. of oil.

INDIANA

EVANSVILLE, Ind.—The lone completion in the flood-ridden Indiana fields was a 717-ft. dry hole in Posey County, drilled by Gulf Refining Co., 1-A Bufkin, SE SW 5-6s-12w.

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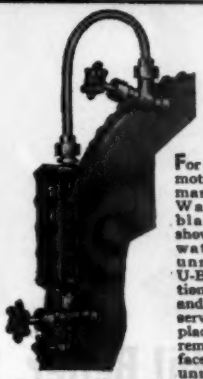
"REFLEX"
WATER GAGE SET



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PERSONALS

Liked Oil Better, So Gave Up Legal Career

E H. EDDLEMAN, who recently became assistant manager for Fleming Oil Co. and Fleming & Kimbell, Fort Worth, started out as a lawyer; but his legal practice drew him into oil, which he liked, with the result that he switched careers. The legal training he got at University of Texas Law School, from which he graduated, and in several years' private practice in Wichita Falls prepared him for responsible posts filled later.

Following service as a captain in World War I, Eddleman became attorney for Texhoma Oil & Refining Co. He was made manager of the land department and crude-oil purchasing department in 1922, and 2 years later was elected vice president. When Texhoma was sold to Continental Oil Co. in 1926, he continued as vice president.

The next year Eddleman resigned to become federal receiver of American Refining Co. At the end of the receivership in 1928 he was made manager of the company's properties, resigning in 1931 to become executive vice president and general manager of Texas Oil and Gas Conservation Association at Fort Worth. Following dissolution of the association in 1933 he held several positions that had a strong oil flavor before he joined the Fleming interests.

Eddleman has been active in refinery association and American Petroleum Institute work. With it all he has acquired some personal oil properties in Wichita and Archer counties, Texas.

Lt. Col. A. B. Stevens, who was professor of petroleum engineering at Texas A. & M. College before entering the armed service, is now with the Military Pipe Line Group in Paris.

Lt. T. F. Estes, formerly section foreman at Bruni, Tex., for United Gas Pipe Line Co., who served 18 months in both the African and Italian theaters with the engineer corps of an oil and gas division, has completed a 30-day leave in the United States and reported at Fort Sam Houston, Texas, for reassignment.

Harold Pauley, vice president of Petrol Corp., recently left the Los Angeles office for Mexico City in the interests of the company's asphalt department.

J. Dodd Toler, formerly supervisor of land records in the secretary and treasurer's department of the Louisiana Division, Standard Oil Co. of New Jersey, at Baton Rouge, was transferred to Interstate Oil Pipe Line Co., Tulsa, March 1. In his new assignment he is assistant to **P. H. Hunter,** secretary. Toler has been in Standard Oil service almost 25 years.

Rudolph Kamon, of Kamon Petroleum Exploration Co., will move his headquarters from Fort Worth to Cisco, Tex., April 1. **Bob Kamon,** now attending University of Texas, will join the company in June.

H. P. ARBUCKLE

H. P. Arbuckle, formerly secretary-treasurer of Neches Butane Products Co., Port Neches, Tex., has been promoted to vice president and secretary. He is a 25-year man with Gulf Oil Corp., on leave of absence to help in the synthetic rubber program. **I. H. Fooshee,** newly elected vice president in charge of manufacturing, is an addition to the executive staff. He, too, is on leave from Gulf and for the past 2 years has been with Rubber Reserve Co. **F. W. Cooper,** formerly assistant treasurer, has been advanced to treasurer. He is on leave from The Texas Co.

J. A. Welch, Rock Island, Ill., who was treasurer and a director of Illinois Oil Co., now in process of dissolution, has been chosen president of Illinois Oil Products, which has taken over assets of the old company. **E. C. Jackson,** Rock Island, is treasurer, and **A. C. Vinton,** Moline, Ill., secretary and sales manager.

C. H. Jones, recently retired as a lieutenant colonel in the Army after service in Africa, Italy and France, has returned to the staff of Stanolind Oil & Gas Co. He was landman at Wichita, Kans., before entering war service.

Frank S. Kelly, Shreveport, industrial engineer for Arkansas Louisiana Gas Co., was reelected president of Southern Gas Association at an executive session of the association in New Orleans. **Clayton L. Nairne,** New Orleans, was reelected vice president. **John E. Warden,** Tulsa, was chosen second vice president, and **L. L. Baxter,** Fayetteville, Ark., secretary-treasurer.

Harold "Smoky Joe" Davis, of Tulsa, whose publications on fire prevention and control have been widely studied in the oil industry, has been named supervisor of fire protection at the Shumaker, Ark., Naval Ordnance Project, with responsibility for organizing, planning and administering its fire protective program. Davis built the fire protection for the Navy at Dutch Harbor and directed all fire fighting at that base and others while they were under attack by the Japs.

C. M. Moore, general superintendent of refining operations for Imperial Oil, Ltd., was elected chairman of the Manufacturers' Association at its annual convention held recently in Calgary.

James A. Dunn, president of Barnsdall Oil Co., is paying a visit to the Tulsa headquarters office of the company.

Erle M. Duffield, Tulsa, has resigned as head of the Oklahoma division land office of The Carter Oil Co. to become manager of the land department of Skelly Oil Co.'s Shreveport division, with his office in Shreveport. He succeeds **R. R. Ransome,** who has been a special

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agent for Skelly in the Carthage district of East Texas. Duffield was an independent operator before he joined Carter.

H. R. Cullen, independent oil operator of Houston, and Mrs. Cullen have endowed three Houston hospitals—the Methodist, Memorial, and Hermann—with $1,000,000 each.

Lt. Joshua S. Cosden, Jr., has returned to the Marine Corps Air Depot at Miramar, Calif., from the Solomon Islands, where he was a communications officer with a First Marine Air Wing group. Before he enlisted for war service in October 1942 Lieutenant Cosden was an executive of Cosco Oil Co., at Wynnewood, Okla. A brother, **Stanley Cosden,** is a Seabee chief petty officer in Rhode Island.

Lt. Col. W. T. Leeper, on leave of absence as vice president in charge of sales for Bayou State Oil Corp., Shreveport, has returned to his former post. Colonel Leeper, upon being called to active duty with the Army Air Forces, was sent to England, where he served for about 2 years.

Edwin F. Nelson, head of the engineering and development departments of Universal Oil Products Co., Chicago, since 1938, has been made a vice president. Nelson, a graduate of University of Wisconsin in chemical engineering, has been on Universal's technical staff since 1926.

Philip Mantor, district petroleum engineer for Humble Oil & Refining Co., has been transferred from the Government Wells district, Freer, Tex., to the Stratton district, Kingsville, Tex. His place at Government Wells has been taken by **Richard J. Lee,** formerly in the company's Southwest Texas division office.

CALENDAR

March

American Petroleum Institute, Pacific Coast District, Division of Production, wartime conference, Biltmore Hotel, Los Angeles, March 29.

April

I.P.A.A., midyear directors meeting, New Orleans, La., April 16-18.

May

American Institute of Chemists, Medal meeting, Columbus, Ohio, May 11.

June

Canadian Gas Association, annual convention, Manoir Richelieu Hotel, Murray Bay, Quebec, June 19-22.

October

Texas Mid-Continent Oil and Gas Association, Rice Hotel, Houston, October 4-6.

I.P.A.A., annual membership meeting, convention city to be selected later, October 15, 16 and 17.

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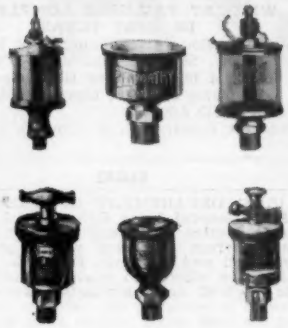

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Permian Basin

(Continued from page 147)

ty, 18 miles northeast of Rankin, was coring deeper after packer failed on attempted drill-stem test at 9,636 ft.

The Texas Co. will drill a wildcat, 1 W. T. Coble, 2 miles west of 1 Montgomery, recent discovery in west central Hockley County. It is 580 ft. from the north and east lines of Labor 20, League 67, Hardeman County School Land.

WILDCAT FAILURES COMPLETED IN WEST TEXAS

Andrews County: Stanolind 1-N Midland Farms, Sec. 15, Blk. 40, T-1-N, T&P Sur., 4 mi. S Mabee field, elev. 2,990 ft., Yates 3,140 ft., Grayburg 4,630 ft., dry, TD 5,000 ft.

Crockett County: T. P. Coal & Oil 1-F M. L. Harris, Sec. 88, Blk. 1, I&GN Sur., elev. 2,212 ft., dry, TD 1,699 ft.

Lynn County: Texas 1 Edwards & Son, Sec. 158, Georgetown RR Sur., 9 mi. NW Tohoka, elev. 3,230 ft., San Andres 4,040 ft., Spayberry 6,490 ft., dry, TD 7,238 ft.

Pecos County: Humble 2 El Paso State Nat'l Bank, Sec. 1, Blk. 141, T&St.L. Sur., ¾ mi. S Apco-Warner pool, elev. 2,478 ft., granite 4,796 ft., dry, TD 4,838 ft.

Standard of Texas 2 J. C. Trees, Sec. 27, Blk. 8, H&GN Sur., 4 mi. S Netterville, elev. 2,556 ft., Delaware 4,710 ft., Bone Springs 8,232 ft., dry, TD 8,232 ft.

Scurry County: Richfield Oil 1 C. D. Cribbs, Sec. 577, Blk. 97, H&TC Sur., 2 mi. NE Fluvanna, elev. 2,747 ft., San Andres 2,145 ft., dry, TD 3,567 ft.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, General Land Office, Washington, D. C. Notice is hereby given that the lands herein described within the Salt Creek oil and gas field, 6th P. M., Wyoming, are offered to qualified bidders of the highest cash amounts offered per acre as a bonus for the privilege of leasing the land under section 17 of the leasing act, as amended by the act of August 21, 1935 (49 Stat. 674, 30 U.S.C., sec. 226), in the following parcels: Parcel No. 1, T. 40 N., R. 78 W., sec. 7, SW¼NE¼, NW¼, NW¼SE¼; 230.12 acres. Parcel No. 2, T. 40 N., R. 78 W., sec. 17, W½SW¼; sec. 18, E½E½, SW¼NE¼; sec. 20, NW¼NW¼; 320 acres. Parcel No. 3, T. 40 N., R. 78 W., sec. 20, E½SW¼; sec. 29, W½NE¼, E½NW¼, NE¼SW¼, SE¼; 440 acres. Parcel No. 4, T. 40 N., R. 78 W., sec. 33, W½NW¼; 80 acres. Parcel No. 5, T. 39 N., R. 78 W., sec. 4, E½W½; 159.09 acres. Parcel No. 6, T. 39 N., R. 78 W., sec. 7, NE¼, SE¼NW¼, 200 acres. Parcel No. 7, T. 39 N., R. 78 W., sec. 7, NE¼SW¼, S½SW¼ N½SE¼, SE¼SE¼; sec. 18, NE¼NE¼; 277.70 acres. Parcel No. 8, T. 39 N., R. 79 W., sec. 4, NE¼, E½NW¼, NE¼SW¼, SE¼; 438.38 acres. Parcel No. 9, T. 39 N., R. 79 W., sec. 13, NW¼NE¼, E½NW¼, W½SE¼; 200 acres. Parcel No. 10, T. 39 N., R. 79 W., sec. 14, N½SE¼; 80 acres. Parcel No. 11, T. 39 N., R. 79 W., sec. 24, SW¼NE¼, NE¼NW¼; 80 acres. Parcel No. 12, T. 39 N., R. 78 W., sec. 17, NW¼SW¼; 40 acres. Parcel No. 13, T. 39 N., R. 78 W., sec. 18, SE¼NE¼; 40 acres. Parcel No. 14, T. 39 N., R. 78 W., sec. 19, NE¼NE¼, N½SE¼NE¼; sec. 20, NW¼NW¼; 100 acres. Parcel No. 15, T. 39 N., R. 78 W., sec. 19, SE¼SE¼; sec. 30, NE¼NE¼; 80 acres. Total acreage 2765.29. Sealed bids will be received in the office of the Commissioner of the General Land Office, Interior Department Building, Washington 25, D. C., up to 12 noon, **April 5, 1945.** Bids must be submitted on each parcel separately but if two or more parcels are awarded to the same bidder they may be included in a single lease provided the aggregate acreage does not exceed 640 acres. Each bidder must submit a certified check or cash for one-fifth of the amount bid, payable to the order of the Treasurer of the United States, and file the showing of qualifications to receive a lease required by section 7 of Circular 1386. The remainder of the bonus bid and the first year's rental at the rate of $1 per acre must be paid and a $5,000 corporate surety bond must be filed by the successful bidders prior to the issuance of the leases. The deposits of the other bidders will be returned upon acceptance of the successful bid by the Secretary of the Interior. The envelopes should be plainly marked "Bid for Parcel No.....", Salt Creek oil and gas field, Wyoming. Not to be opened before noon—April 5, 1945." No bids received after the date fixed herein for submitting bids will be considered. The successful bidder will be required to agree not to discriminate against any employee or applicant for employment because of race, creed, color, or national origin, and to require an identical provision to be included in all subcontracts. Bidders are warned against violation of section 59, U.S. Criminal Code, approved March 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids in the discretion of the Secretary of the Interior. Fred W. Johnson, Commissioner.

PANHANDLE

AMARILLO.—Humble Oil & Refining Co. 1 J. W. Hyslop, wildcat 35 miles from Hereford in southwestern Deaf Smith County, retreated through perforations at 6,485-6,505 ft. and swabbed salt water and drilling mud with no shows of oil or gas. Tubing is being pulled to run packer and squeeze perforations from 6,485-6,505 ft. Total depth is 7,805 ft. in granite.

WILDCAT FAILURE COMPLETED IN PANHANDLE

Sherman County: Humble 1 Pronger Bros., Sec. 317, Blk. 1-T, T&NO Sur., 7½ mi. S Stratford, elev. 3,733 ft., dry, TD 5,346 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—The Texas Co. 1 J. S. Eaves, wildcat in eastern Lea County, 14 miles north of Hobbs, acidized with 2,000 gal. at 5,160-5,667 ft., total depth, and swabbed 20 bbl. of fluid, mostly water, in 24 hours with slight show of oil and gas. Swabbing is being continued. Skelly Oil Co. 2 Steeler, wildcat 6 miles from Gulf Oil Corp. 1 Drinkard, is drilling below 6,865 ft. under a new contract to at least 7,500 ft. It failed to produce from the pay zone of the discovery well, which was 6,345-6,445 ft. A 1¾-hour drill-stem test was made at 6,685-6,815 ft. and 1,033 ft. water blanket and 279 ft. of drilling mud, both cut with gas and slightly cut with oil, was recovered. There was a small blow of air throughout the test.

Humble Oil & Refining Co. 2 Federal-Leonard, in the Dublin area of southeastern Lea, is drilling below 5,993 ft. in lime. Continental Oil Co. 3-B-23 Skaggs, second test in the Skaggs deep area of Lea County, logged its first porosity at 5,350 ft. with slight oil stains at 5,380 ft. On a 75-minute drill-stem test at 5,350-5,540 ft., 1,260 ft. of drilling mud and 1,080 ft. of sulfur water was recovered. It is being drilled ahead.

Texas is drilling a new wildcat 6 miles south of the east side of the Vacuum pool in Lea County. It is 1 Jamie P. Reeves, located 1,980 ft. from the south and east lines of Section 26-18s-37e.

Oklahoma Fields

(Continued from page 151)

was being tested in dolomite topped at 8,898 ft.

SUCCESSFUL WILDCAT COMPLETIONS IN OKLAHOMA

Coal County: Discovery, OWWO. Carter 1 Thompson, S/2 NE NW 34-2n-9e, OTD 7,126 ft., as a dry hole, PBTD 4,908 ft., pump and flow 60 bbl. of 40.3°-gravity oil from pay zone 4,850-78 ft. and 4,888-98 ft., after acid. Cromwell 4,850 ft.

Garfield County: Discovery. Can-Tex 1 Wolfe, NE SW SW 34-24n-3w, flowed 352 bbl. of 45.7°-gravity oil from pay zone 4,837-47 ft., TD 4,847 ft., elev. 1,001 ft., dolomite 4,805 ft., Wilcox 4,828 ft., second Wilcox 4,838 ft.

WILDCAT FAILURES COMPLETED IN OKLAHOMA

Beckham County: Sinclair Prairie 1 Perkins, NE NW 11-9n-24w, dry, TD 7,685 ft., granite wash 3,700 ft., Hoxbar 5,475 ft., brown Pennsylvania lime 5,953 ft.

Canadian County: Amerada et al 1 Lawson, NE SE NW 18-11n-5w, dry, TD 9,549 ft., Viola 8,910 ft., Simpson 9,085 ft., Wilcox 9,205 ft., second Wilcox 9,338 ft.

Garvin County: Sun 1 Tolbert, W/2 NE NE SW 14-3n-1e, dry, TD 3,511 ft., Wilcox 3,490 ft.

Logan County: Eason Oil 1 Threlkeld, SW SW SW 13-15n-3w, dry, TD 6,303 ft., Wilcox 6,120 ft., second Wilcox 6,216 ft.

Love County: Magnolia 1 Stewart, SW SW 7-7s-3e, dry, TD 5,496 ft., bromide dense 5,017 ft., bromide shale 5,120 ft.

Sohio 1 Cartwright, SE NE SE 21-8s-2e, dry, TD 7,458 ft., brown Pennsylvania lime 7,320 ft.

McClain County: Carter 1 Johnson, SW NE 30-8n-2w, dry, TD 8,267 ft., bromide dense 8,123 ft., bromide sand 8,212 ft.

Seminole County: E. N. Jordan 1 Collins, SE SW NW 6-5n-6e, dry, TD 2,330 ft., Sonora lime 2,016 ft.

Sequoyah County: Arkansas-Oklahoma 1 Hash, E/2 NE 32-12n-24e, dry, TD 2,158 ft.

Stephens County: Brigance & Shine 1 Poe, SE SE NE 7-3s-4w, dry, TD 2,380 ft.

Washita County: California 1 Reeder, NE NW 1-8n-17w, dry, TD 11,130 ft., Arkosic sand 7,985 ft., Dornick Hills 10,450 ft.

Rocky Mountain Area

(Continued from page 151)

in a region approximately 120 miles long by 70 miles wide which has been highly regarded but never tested, due to the great depth, and changes in the federal leasing laws which held up exploration several years ago when major companies took up large blocks. Around the rim of this basin in a semicircular form are Salt Creek, Big Muddy, Cole Creek, Lance Creek and other producing fields. A deep test to the Tensleep at Cole Creek is in the offing. The field is operated by the General Petroleum Corp. and lowest horizon tested is the Lakota at around 8,000 ft.

Oil show at Sheldon dome.—Kerlyn Oil 1 Shoshone, NE NE 16-5n-2w, Sheldon dome, Fremont County, Wyoming, picked up some saturation in the Dinwoodie at 6,231-38 ft. Three attempts to make a drill-stem test failed and drilling was resumed. More saturation was found at 6,267-74 ft. Bottom of the hole is about 250 ft. off the objective Tensleep.

Oil in Dakota at Midway.—Kerlyn Oil Co.-Phillips Petroleum Co. 1 Kerlyn-Government, NE SE NE 23-35n-79w, Midway field, Natrona County, Wyoming, a test to the Tensleep, cored saturation in the Dakota at 5,939-73 ft. and is preparing to make a drill-stem test. The field is producing from the Wall Creek. One test was drilled to the Dakota several years ago and had saturation, but difficulty was encountered in shutting off water which came from the Lakota sand below the Dakota and it was plugged back and completed in the Wall Creek. The objective Tensleep is expected at 8,300 ft.

WILDCAT FAILURE COMPLETED IN WYOMING

Mahoney, Carbon County: Sinclair-Wyoming 7-C C & F unit, C N½ 34-26n-88w, TD 5,366 ft., PB 4,508 ft. and completed in Tensleep, swabbed 13 bbl. fluid in 17 hours, 40 per cent oil and 60 per cent water after acidizing with 1,000 gal., completed as a pumping well after testing horizons below Tensleep.